Chapter 3 Conditions and Trends

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Chapter 3 – Figures and Tables

Aquatic Ecosystem

The White Chuck River is the largest tributary of the upper Sauk River. The White Chuck River originates from Glacier Peak on the east and White Mountain on the south. At 10,568 feet, Glacier Peak dominates the landscape in this portion of the northern Cascades. Glacier Peak spawns three named glaciers (Kennedy, Scimitar, and Sitkum) that feed the White Chuck River. Additional snowfields and glaciers between Glacier Peak and White Mountain blanket the ridges dividing the White Chuck and Suiattle Rivers. White Chuck Glacier feeds a small moraine lake, the origin of the White Chuck.

The White Chuck River is currently mapped as a sixth-field watershed (termed a "subwatershed") for the revised watersheds of the Mt. Baker-Snoqualmie National Forest. Under the old watershed system (pre-2003), the White Chuck was considered a fifth-field watershed.

The White Chuck subwatershed is divided into two drainage areas (7^{th}-field watersheds) for this watershed analysis: The Upper White Chuck (171100060105) and the Lower White Chuck (171100060106). These drainage areas split the White Chuck River into two areas at Fire Creek (approximately River Mile 14). The lower White Chuck drainage area is larger than the upper drainage area, 29,935 acres and 24,574 acres, respectively.

The White Chuck River is approximately 35 miles in length, flowing in a northwest direction and joining the Sauk River at River Mile 31.9. The drainage density is relatively high, 660 miles of stream in 85.2 square miles, or an average density of 7.75 miles/square mile.

Watershed-Scale Assessment

The White Chuck River watershed was preliminarily assessed to determine baseline conditions of fish and fish habitat indicators for chinook and bull trout, per criteria established in the USFWS Matrix of Diagnostics/Pathways and Indicators (*in:* USFWS 1998). The objective of the matrix is to integrate the biological and habitat conditions to arrive at a determination of the potential effect of land management activities on a proposed or listed species. Of the 24 subpopulation and habitat diagnostic indicators, only one indicator (Road Density and Location) was identified as "functioning at-risk" in the White Chuck. All other indicators were "functioning appropriately". The primary fish stocks of concern associated with this project are (upper Sauk) spring chinook and bull trout.

Aquatic Habitat

Critical Habitat

Critical habitat is a term within the Endangered Species Act (ESA). It is defined as an area occupied by a species listed as threatened or endangered within which are found physical or geographical features essential to the conservation of the species, or an area not currently occupied by the species, which is itself, essential to the conservation of the species. As defined in the ESA, "conservation" means any and all methods and procedures, and the use of those, needed to bring a species to recovery—the point at which the protections of the ESA are no longer needed. No Critical Habitat has been designated in the White Chuck Watershed.

Essential Fish Habitat

The Sustainable Fisheries Act of 1996 amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for Essential Fish Habitat (EFH) descriptions in Federal fishery management plans and to require Federal agencies to consult with NMFS on activities that may adversely affect EFH. Essential Fish Habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

The Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Pacific salmon: chinook, coho, and pink salmon (PFMC 1999). EFH for chinook and coho is present in the White Chuck, but pink salmon EFH is not considered present in the White Chuck.

Instream Habitat

Biological surveys have been documented for the White Chuck watershed at least as early as 1921 (Smith and Anderson, 1921), but it wasn't until the 1980s that protocols were developed in an attempt to provide consistency and repeatability to biological and physical habitat surveys.

Much of the survey information is now dated, and protocols have evolved. Table 1, page 5 displays habitat attributes for the White Chuck river mainstem (more recent information is unavailable) and for selected streams with data collected since the 1990s.

Side channels of the mainstem and other off-channel habitats are important for both spawning and rearing. The White Chuck has limited off-channel habitats, however, with only about 1.5 miles along the mainstem (Barkdull, personal communication). However, significant channel migrations and wood depositions during the October 2003 flow events may have set the stage for creation of new off-channel habitat that may become important for fish.

In-channel Large Wood

An important attribute of stream and riparian corridors is the distribution and abundance of large woody debris (LWD). In Pacific Northwest streams, large woody debris plays an important role by influencing channel morphology, creating and enhancing fish habitat (Bisson et al. 1987). Logs and root wads enter stream channels due to bank cutting, blowdown, and mass wasting. The probability that a falling tree will enter a stream is a function of slope and distance from the channel in relation to tree height (McDade et al. 1990). Pools formed in association with LWD provide deep, low velocity habitat with cover beneficial for a variety of salmonid species and life history stages. LWD often traps and stores sediment (affecting sediment transport rates), retains spawning gravels, functions to dissipate energy, and provides thermal and physical cover.

The nature and abundance of LWD in a stream reflects past and present recruitment rates from the riparian area. Activities that remove riparian vegetation can reduce LWD recruitment. Current LWD conditions also reflect the history of both natural and management-related channel disturbances, such as flood events, debris flows, and streamside harvest. Refer also to Riparian Conditions Chapter 3, page 21, for a discussion on wood recruitment.

The Forest Service Pacific Northwest Region categorizes wood into three size classes for Westside forests, and considers the large class (24 inches or greater in diameter and at least 50 feet long) to have the most benefit, recommending greater than 80 large pieces per mile (USFS and BLM 1995). While 80 pieces per mile is also supported by USFWS (1998) and NMFS (1996), Doyle (1999) recommends that the location and complexity of this wood, which varies with channel type and size, also needs to be considered when evaluating LWD.

The following is also included as a reference for desired levels: those reaches of Boulder River (NF Stillaguamish) within Boulder River Wilderness contained 53 pieces of (large) wood per mile during a 1992 survey; within the Glacier Peak Wilderness, the lower 6 miles of Downey Creek (Suiattle River) contained 118 pieces with the above dimensions during a 1993 survey. The range of natural instream wood can be quite variable, as Doyle suggests.

While numbers of large wood per mile for White Chuck tributaries appear to be low, wood accumulations in jams is not included in the calculation, which may be the more important indicator for wood in higher gradient streams. Instream wood has increased in the mainstem White Chuck due to tributary transport and from channel migration during the October 2003 floods. Wood routing is considered to be functioning appropriately.

Pool Habitat

Pools provide important habitat for salmonid rearing, for low flow protection from predators and elevated water temperatures, for winter refuge, and for holding areas for spawning adults. Spawning occurs at pool-riffle transitions, and different fish species utilize pools throughout the year at varying life stages. Fishery managers believe that coho production in the Sauk watershed is limited by winter rearing habitat (WDFW 1995).

Pool frequency (number of pools over a given distance) is a key feature for salmonids and is inversely related to the low flow wetted width of a stream. Peter (1993) defined the range of natural conditions for pool frequency based upon a wetted width range of 10-50 feet. Historically, 25-100 pools per mile existed in the Sauk River basin (Peter 1993). Pool frequencies for streams with more recent survey information (Table 2 through Table 6) had a broader range than expected for natural conditions. Possible reasons for this include survey protocol and management influences. Frequencies were generally within the natural range.

Pool spacing, or number of channel widths between pools, is another way to assess pool habitat. WFPB (1997) suggests that for channels with less than 49' bankfull width and at any gradient, good pool quality is present if there are less than two channel widths per pool. Fair quality is two to four channel widths, and more than four widths is poor. The Forest Service and Bureau of Land Management (USDA and USDI 1994b) have a criterion using wetted widths: 2-6 wetted channel widths per pool is high quality; 7-10 widths are moderate; >10 widths are low. Using WFPB ratings, pool spacing (frequency) for White Chuck tributaries is low except for those reaches surveyed by AREMP crews. Crystal and Stujack Creeks had good pool frequencies, but the reaches were very short. Owl and Dead Duck Creeks had moderate pool frequencies. Using FS/BLM criteria, pool frequencies were poor except for the lowest 0.31mi of Owl Creek, which was moderate.

Pool area (percentage of habitat in pools) is inversely related to stream gradient. The Washington Forest Practices Board (WFPB 1997) suggests that for stream channels greater than 5 percent gradient with bankfull widths less than 49 feet wide, that less than 20 percent pool habitat is poor. WFPB does not suggest an upper limit for gradients greater than 5 percent, nor is a separate rating for streams with bankfull widths significantly less than 49 feet.

Pool habitat in White Chuck tributaries again appears to be lacking, a function of high gradients and lack of pool forming features such as wood. Large substrate may provide pools but the quality may be limited. Pool habitat could likely be better, particularly where past management activities removed wood that helped to stabilize a channel and provided for instream complexity. Managed streams were found to have statistically significant less pool habitat than unmanaged streams (*in* Peterson et al. 1992).

Table 1 1981 Forest Survey For Selected Streams Within the White Chuck Watershed

Key of abbreviated information: BO=boulders, CO=cobbles, GR=gravels, SA=sand/silt/clay; DF=deep/fast, DS=deep/slow, SF=shallow/fast, SS=shallow/slow; side channel habitat adds to pool habitat to total 100%

Reach (River Mile)	Substrate Percentage				Pool Habitat Percentage				Side Channel Habitat Percentage		Comment
	BO	CO	GR	SA	DF	DS	SF	SS	SF	SS	
1 (0-1.37)	30	50	10	10	40	15	20	20	0	5	Woody debris on gravel bars; very unstable slides
2 (1.37-3.4)	15	45	30	10	30	10	30	15	10	5	Broad, low gradient, swift and deep (pools). Very turbid. Debris moderate-low, gravel shifts
3 (3.4-4.4)	7	68	15	10	30	10	30	20	5	5	Deep holes; more gravel than upstream; flat, more stable; debris moderate, less than above Crystal Creek
4 (4.4-6.25)	10	70	15	5	50	5	25	10	5	5	Overbank flows common; peak flows limiting eggs and juveniles; continuous bank cutting; high levels of large debris
5 (6.25-7.75)	10	60	20	10	-	-	-	-	-	-	Swift, deep, well-scoured; almost continuous bank-cutting; high unstable cut banks with trees falling into channel
6 (7.75-9.1)	10	70	15	5	30	10	25	20	5	10	Scouring, wood inputs; high, steep gravel bars; bedload shifting; pink, coho
7 (9.1-11.75)	10	60	20	10	60	20	10	10	0	0	Swift, deep; high runoff flows with turbidity; abundant debris; steelhead, coho juveniles, pink
8 (11.75-12.75)	10	60	20	10	40	15	30	15	0	0	Flood-ravaged appearance; ’80 flood; frequent slides; debris plentiful, loosely embedded; steelhead, coho juveniles, pink adults

Table 2 Owl Creek

Key of Abbreviated Information for the following tables: BFW = Bankfull Width; BFW:BFD=Bankfull width to bankfull depth ratio; LWD=Large Woody Debris AREMP=Aquatic and Riparian Effectiveness Monitoring Program; data were being processed and were limitedly available.

Survey Type and Year	Reach (River Mile)	Grade %	(a) Low Flow Width		Pools per Mile	Pool Spacing (Channel widths between pools)		Pool Area %	LWD per Mile	(b)BFW:BFD
			Wetted	BFW		Wetted	Bankful			
Level II, 1997	1 (0-0.31)	-	17	19	44.9	6.9	6.2	26	54.5	12.8
	2 (0.31-2.1)	-	13	20	29.6	13.7	8.9	16	61.5	15.5
AREMP 2003	1-3 (tot. len.= 0.31mi)	NA	NA	14	108	-	3.5	NA	12.9	NA

Table 3 Dead Duck Creek

Survey Type and Year	Reach (River Mile)	Grade %	(a) Low Flow Width		Pools per Mile	Pool Spacing (Channel widths between pools)		Pool Area %	LWD per Mile	(b)BFW:BFD
			Wetted	BFW		Wetted	Bankful			
Level II, 1992	**1 (0-0.69)**	**15**	**9**	**-**	**27.6**	**21.3**	**-**	**6.7**	**52**	**-**
AREMP 2003	**1 (total length = 0.09mi)**	**NA**	**-**	**24**	**63.5**	**-**	**3.5**	**-**	**42.3**	**NA**

Table 4 Stujack Creek

Survey Type and Year	Reach (River Mile)	Grade %	(a) Low Flow Width		Pools per Mile	Pool Spacing (Channel widths between pools)		Pool Area %	LWD per Mile	(b)BFW:BFD
			Wetted	BFW		Wetted	Bankful			
Level II 1992	1 (0-0.68)	20	9	-	44.1	13.3	-	12.9	8.0	-
Level II 2000	1 (0-0.53)	20	14	-	11.3	33.3	-	3.6	7.5	15.5
AREMP 2003	1 (total length =0.12 mi)	NA	NA	14	114.4	-	1.4	NA	24.5	NA

Table 5 Black Oak Creek

Survey Type and Year	Reach (River Mile)	Grade %	(a) Low Flow Width		Pools per Mile	Pool Spacing (Channel widths between pools)		Pool Area %	LWD per Mile	(b)BFW:BFD
			Wetted	BFW		Wetted	Bankful			
Level II 1991	1 (0-0.5)	8	11	-	9.9	48	-	4.7	19.9	-
Level 11 2000	1 (0-0.75	8	11	24	24.0	20	-	6.9	0	12

Table 6 Crystal Creek

Survey Type and Year	Reach (River Mile)	Grade %	(a) Low Flow Width		Pools per Mile	Pool Spacing (Channel widths between pools)		Pool Area %	LWD per Mile	(b)BFW:BFD
			Wetted	BFW		Wetted	Bankful			
AREMP 2003	1 (total length =0.16 mi)	NA	-	36	132.6	-	1.1	NA	6.3	NA

Lakes

Based on information in Wolcott (1973), there are at least eight named and four unnamed lakes in the White Chuck analysis area. Physical and biological data for these lakes are limited. Most Cascade Mountain high-elevation lakes (greater than 2,500 feet elevation) were historically devoid of fish due primarily to the lack of access to the lakes from downstream areas of fish-bearing streams and rivers. The presence or absence of fish and the species composition in many of the high lakes is unknown. A number of factors determine whether fish can survive in these lakes. Factors include availability of spawning and rearing habitat, food, and feeding areas. Each fish is adapted to particular conditions and has specific habitat requirements. One square foot of spawning area has the potential to fully seed one acre of lake with stunted fish (Johnston, personal communication). Several of the named lakes within the analysis area have been stocked (see Table 10).

Table 10 Partial[1] Fish Stocking History, Selected Streams/Lakes Within the Analysis Area

Name	Year Stocked	Species	Quantity
Camp Creek	1941	Rainbow Trout	11,350
	1945	Rainbow Trout	14,000
Pugh Creek	1941	Steelhead	11,370
	1941	Rainbow Trout	22,470
	1945	Rainbow Trout	14,000
Dead Duck Creek	1941	Steelhead	11,430
Lake Byrne	1968	Cutthroat Trout	6,264
	1983	Golden Trout	2,000
Camp Lake	1942	Rainbow Trout	12,640
	1969	Rainbow Trout	1,500
	1983	Golden Trout	750
Crystal Lake	1941	Rainbow Trout	22,600
	1968	Cutthroat Trout	2,016
	1984	Rainbow Trout	500
Fern Lake	1983	Golden Trout	100
Round Lake	1939	unknown	unknown
	1965	Golden Trout	1,050
	1970	Rainbow Trout	800

., page 14), and are likely still on a stocking rotation by WDFW. While cutthroat and rainbow were the dominant species used, golden trout had also been introduced to the area. Various strains of trout have been used for lake stocking by WDFW, including Twin Lakes, Tokul Creek, West slope, Yellowstone, Montana black spot cutthroat, and Mt. Whitney rainbow. Tokul Creek cutthroat are a typical low elevation strain, while those from Twin Lakes are generally used to stock high elevation lakes. Despite being high elevation, most lakes may have been stocked with Tokul Creek fish, as the Twin Lakes fish have a tendency to overpopulate and lead to stunted populations (Johnston, personal communication). Stocking fish can draw people to these lakes, which could cause indirect impacts such as soil compaction, disturbance to riparian areas and lakeshores, and increased nutrients from human/domesticated animal waste.

Restoration

Formal watershed restoration on the Mt. Baker-Snoqualmie National Forest began in fiscal year 1995. The ROD (USFS 1994) outlines four components of an Aquatic Conservation Strategy (Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration), and describes the goals and objectives of watershed restoration, which are integral to recovery of fish habitat, riparian habitat, and water quality. Restoration strategies are comprehensive, addressing both the protection of physical and biological processes and functions of the best habitats that remain (refugia) and restoration of those processes and functions of degraded habitat. Restoration activities should be integrated into a program designed to protect and restore upslope, riparian, and channel components of watersheds, including physical, chemical, and biological characteristics. Treatments should be carefully applied so that they accelerate natural recovery. Restoration activities also must be designed and carried out in ways that advance the goal of increasing the capacity of the Western Washington province's communities and workers to improve their economic and social well being. Recognition of this goal as a key part of watershed restoration in and around the Forest ensures that short and long-term economic benefits are compatible with environmental goals.

In the White Chuck Analysis Area, restoration activities would benefit fish and aquatic species by reducing human-influenced sedimentation above an already high natural loading, and by increasing or enhancing off-channel habitat quantity or quality. Activities might include treatment of upslope drainage problems associated with roads through either closure or obliteration, or through reconstruction of roads to improve local hydrology. Where roads are needed, opportunities to relocate them out of riparian areas and away from fish-bearing waters should be considered as well as improving the drainage structure. Retaining adequate forest canopy will help reduce impacts to the flow regime. Removing fish passage barriers provide an immediate and long-lasting benefit to all fish species. Because restoration of habitat does not often have immediate results, instream habitat improvements can also be done to provide temporary benefits. Impacts to riparian and aquatic habitats from recreational use can be assessed and treatments considered addressing problem areas. As watershed analysis is required before most management activities, recent work has been limited. See Table 7 Restoration Work Within the White Chuck Watershed for a sampling of some activities intended to have direct and indirect benefits to aquatic species.

Table 7 Restoration Work Within the White Chuck Watershed

Location	Date	Description
Black Oak Creek	1990 1991	70 instream log deflectors for rearing complexity, stability 32 log deflectors for rearing complexity, stability
Two Pink	1992	90 logs in side channel of WhiteChuck for spawning
Dead Duck	mid-1990s 1996/97	Slope stabilization at various sites Replace culvert, dip road
Crystal Camp Road	1999	Culvert removal for fish passage
Owl Creek	1999	Replace culvert with bridge for fish passage
White Chuck RM 1.0	1985	21 log deflectors in side channel of river
White Chuck RM 1.7	1988	5 blasted pools in side channel
Various		Limited planting of salmon carcasses to increase availability of marine-derived nutrients.

Table 8 Fish Species in the White Chuck River Watershed

Name	Common Name	Scientific Name
Chinook	King	*Oncorhynchus tshawytscha*
Coho	Silver	*Oncorhynchus kisutch*
Pink		*Oncorhynchus gorbuscha*
Sockeye		*Oncorhynchus nerka*
Bull Trout/Dolly Varden		*Salvelinus confluentus/ Salvelinus malma*
Steelhead/Rainbow		*Oncorhynchus gairdneri*
Coastal Cutthroat	Sea-Run Cutthroat	*Oncorhynchus clarki clarki*
Mountain Whitefish		*Prosopium williamsoni*
Sculpin species		*Cottus spp.*
Dace species		*Rhinichthys spp.*

Table 9 Summary of Selected Fish in the White Chuck Analysis Area

NMFS—National Marine Fisheries Service or NOAA (National Oceanic and Atmospheric Administration) Fisheries; USFS—United States Forest Service; USFWS—United States Fish and Wildlife Service; SASSI—Washington State Salmon & Steelhead Stock Inventory (WDF et al. 1993; WDFW and WWTT 1994); SaSI—Washington Salmonid Stock Inventory (WDFW 1998).

Species/Stock	Status	Primary Utilization	Limiting Factors
Chinook	NMFS—Listed threatened USFS—Sensitive SASSI—Depressed; chronically low numbers	White Chuck mainstem to RM 10.4; large tributaries: Camp, Owl, Pugh	
Coho	NMFS—Candidate USFS—Sensitive SASSI—Depressed; short-term severe decline	White Chuck mainstem to Owl Ck. (RM 9.8), with habitat to Fire Ck. (RM 12.8); lower reaches of Camp, Owl, Pugh, Crystal, Dead Duck, Stujack, Black Oak, and some unnamed tributaries	Steeper gradients in tributaries and lack of low-gradient off-channel habitats along mainstem
Steelhead (Winter)	SASSI—Healthy	Mainstem spawning up past Camp Creek, to about RM 11; presumed use up to about RM 18. Tribs: Owl, Pugh, Stujack, Black Oak Creeks	
Sockeye (riverine, not Baker River stock)	NMFS—Candidate (Baker River stock in Skagit) USFS—Sensitive	Mainstem up to and including lower Camp Creek	Undetermined; riverine sockeye are not a distinct stock, and are not routinely inventoried
Coastal sea-run cutthroat	NMFS—Candidate USFS—Sensitive SaSI—Healthy	White Chuck mainstem up to and including lower Crystal Creek	Steeper gradients; lack of low-gradient off-channel habitats.
Native char—Bull trout/Dolly Varden, fluvial/ anadromous	USFWS—Listed threatened USFS—Sensitive SaSI—Unknown	White Chuck up to about RM 19, near Baekos Creek. Upstream of Baekos Creek, habitat is present but spawning has not been confirmed.	

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Camp Creek	1941	Rainbow Trout	11,350
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	1968	Cutthroat Trout	2,016
	1984	Rainbow Trout	500
Fern Lake	1983	Golden Trout	100
Round Lake	1939	unknown	unknown
	1965	Golden Trout	1,050
	1970	Rainbow Trout	800

Table 11 Timing of Salmon, Sea-run Trout and Char Freshwater Life Phases in the White Chuck River/Tributaries.

Early is considered about the first week of the month and late is around the third week of the month
[1]Stocking information is incomplete.

Stock	Upstream Migration	Spawning	Intergravel Development	Rearing	Outmigration
Chinook (Sauk spring)	May—end Aug	early Aug—mid-Sept	early Aug—end Feb	Year-round	late Feb—mid-Jun
Coho	Sept—and Dec	Nov—early Feb	Nov—end May	Year-round	Apr—end Jun
Steelhead (winter)	mid-Dec—early Jun	mid-Mar—mid-July	mid-Mar—early Sept	Year-round	mid-Mar—mid-Jul
Sockeye (riverine)	Jul—end Sept	mid-Aug—end Oct	mid-Aug—mid-Jun	Year-round	mid-Mar—mid-Jul
Coastal sea-run cutthroat	Oct—mid-Mar	mid-Feb—mid-Jun	mid-Feb—mid-Jun	Year-round	end Mar—mid-Jul
Native char—Bull trout/Dolly Varden, fluvial/anadromous	May—end Sept	late Sept—end Oct	late Sept—mid-May	Year-round	early Mar—end Jun

Fish Species

The White Chuck River provides habitat for fish species listed as Threatened under the Endangered Species Act, those listed as "Sensitive" by the Pacific Northwest Region of the Forest Service, and other anadromous and resident fish species (see Table 8).

Chinook

(Federal Threatened Species, Puget Sound Evolutionarily Significant Unit [ESU], March 1999)

Chinook utilizing the White Chuck are managed as part of the upper Sauk spring stock. Main stem and large tributary spanners, chinook are known to spawn up to approximately RM 10.4, with known tributary spawning in lower Camp, Owl, and Pugh Creeks. Rearing occurs in the main stem along gravel bars and in/around tributary confluences. Some chinook will only rear in freshwater during their first summer then rear in the Skagit estuary, while others will rear a full year.

Native Char

Bull Trout (Federal Threatened species) and Dolly Varden

Native char in the White Chuck are considered part of the Lower Skagit bull trout/Dolly Varden stock. The bull trout population in the Skagit system is considered by local biologists to be the most abundant in Puget Sound. Both species exhibit similar life history characteristics and habitat requirements, and they are managed the same due to similarity of appearance. Native char require cold-water temperatures for spawning and incubation, with spawning triggered by temperatures around 8C (46°F) and are known to utilize the White Chuck up to about RM 19, within the Glacier Peak Wilderness near Baekos Creek. Upstream of Baekos Creek, habitat is present but spawning has not been confirmed. Early rearing occurs in close proximity to spawning habitat, but juveniles will disperse downstream throughout the system to rear.

Char are piscivorous and feed on smaller fish besides macroinvertebrates and the eggs of salmonids.

Coho

(Federal Candidate species, Puget Sound/Strait of Georgia ESU, July 1995; Forest Service Sensitive)

Coho in the White Chuck are part of the Skagit coho stock. Coho generally utilize smaller tributaries and off-channel habitats. They have been found in the White Chuck as far as Owl Creek (RM 9.8). Habitat is available up to about Fire Creek (RM 12.8), where natural stream gradients make access more difficult and habitat less attractive. Coho are known or presumed to utilize the lower reaches of Camp, Owl, Pugh, Crystal, Dead Duck, Stujack, and Black Oak Creeks, as well as some of the unnamed tributaries. Coho rear for about a year in freshwater, distributing downstream throughout the river system.

Steelhead

Steelhead stocks in the Puget Sound ESU were determined by NMFS to be "Not Warranted" for federal listing under ESA in August 1996. Two steelhead stocks utilize the Sauk basin: Sauk winter steelhead, and Sauk summer steelhead. Winter steelhead comprises up to 95 percent of the steelhead in the basin and utilizes most of the Sauk basin. Steelhead in the White Chuck are part of the Sauk winter steelhead stock, and are found spawning up past Camp Creek, to about RM 11. Local biologists presume use in the mainstem up to about RM 18, however. Tributaries with known or presumed use include Owl, Pugh, Stujack, and Black Oak Creeks. Rearing occurs in all accessible areas downstream.

Other Fish Use

Other salmonids limitedly using the White Chuck include pink and sockeye salmon, and sea-run cutthroat. Odd-year pink salmon were designated by NMFS as "Not Warranted" for federal listing in October 1995. The Puget Sound ESU for coastal cutthroat was designated by NMFS as "Not Warranted" for federal listing in April 1999.

Pink in the White Chuck are considered strays and not a contributing part of the Skagit stock. Two individuals were seen at RM 1.6 in 1989; five individuals and two redds were seen at various locations during habitat surveys in 1981.

Sockeye found in the Sauk watershed are not recognized as a distinct stock. In the White Chuck, use has been documented in the mainstem up to and including lower Camp Creek. Information on sockeye is lacking; sockeye are not managed for harvest.

Coastal (sea-run) cutthroat trout (Forest Service Sensitive Species) have been found in the White Chuck mainstem up to and including lower Crystal Creek. Habitat is limited for these fish due to steeper gradients.

Chum does not appear to use habitat in the White Chuck. The Puget Sound/Strait of Georgia ESU for chum salmon was designated by NMFS as "Not Warranted" for federal listing in March 1998.

Resident salmonids in the White Chuck include cutthroat, rainbow, char, and mountain whitefish. Sculpin and dace are other resident fish.

Non-native fish species have also been introduced into the watershed through stream and lake stocking.

Trends in Aquatic Habitat and Fish Species

At-risk fish stocks in the region may continue a short-term decline as recovery plans are implemented with expected recovery of fish stocks over the long term. Habitat conditions will improve as riparian areas on National Forest are allowed to recover from past management, and sources of accelerated sediment are reduced. These improvements to sediment sources and fish passage may be delayed by lack of funding. Fish access will improve as barriers are identified and removed.

Demand for salmon produced from all ownerships in the Statewide Comprehensive Plan for Area 1 (most of the western half of Washington State, north of the Cowlitz River, and including all of the Olympic Peninsula) is estimated to increase by 15 percent (estimated from USDA Forest Service1990). This estimate is based on the demand increase from 1970 to 2000.

Resident fish numbers are expected to remain at current levels over the short-term. In the long-term, resident fish, numbers may decline due to increased recreational fishing pressures, particularly as restrictions on anadromous salmon become tighter.

Emphasis on upslope watershed restoration, and riparian and instream habitat restoration, is expected to continue over the next few years. Upslope restoration will focus on decreasing both the numbers and magnitude of resource responses to natural processes, while instream habitat improvements associated with restoration activities will help in the shorter term providing benefits while upslope conditions improve. Cooperative restoration efforts with local Tribes, County/State/Federal agencies, non-profit groups, and private landowners are expected to increase over time. Effective monitoring efforts are also expected to increase with time.

Water Quality

One of the concerns identified in Chapter 2 is the protection or maintenance of the high water quality of the White Chuck River. The water quality has not been tested in any rigorous way, but the low level of human-caused (anthropogenic) disturbance or pollution in the watershed lowers the potential for water quality degradation.

Streams

Water quality concerns relate to the beneficial use of the water that, under the Washington Department of Ecology State Water Quality Standards (Washington Department of Ecology 1997), is for spawning and rearing habitat for anadromous fish. High water quality is also important for a host of other riparian-dependent species and amphibians.

The White Chuck River is not listed on the 303(d) list of impaired water bodies (Washington Department of Ecology 1998) this does not mean there are no water quality impairments, but there are no data that indicate a problem exists.

The Zone Hydrologist sampled the White Chuck River at the White Chuck Campground three times during 1971-1972 (unpublished data, unknown quality control). These spot samples found relatively low turbidity, although the units of measure are not certain. Conductivity ranged from 25 to 43 (units not specified).

Additional data from stream surveys are summarized in Table 13. Spot Water Temperatures From Selected Level II Stream Surveys and Table 12 Channel Stability Results From Level II Stream Surveys

Table 12 Channel Stability Results From Level II Stream Surveys

White Chuck and Tributary Stream Name	Survey Date	Reach (R) River Mile (RM)	Stability Score	Rating
White Chuck River	1981	R1, RM 0-1.37	101	Fair
		R2, RM 1.37-3.4	95	Fair
		R3, RM 3.4-4.4	101	Fair
		R4, RM 4.4-6.25	128	Poor
		R5, RM 6.25-7.75	120	Poor
		R6, RM 7.75-9.10	124	Poor
		R7, RM 9.1-11.75	119	Poor
		R8, RM 11.75-12.75	123	Poor
Black Oak Creek	1981	R1	75	Good
Tributary 1118	1981	R1	69	Good
Stujack Creek	1981	R1, RM 0-0.1	71	Good
	1992	R1, RM 0-0.65	91	Good
Dead Duck Creek	1992	R1, RM 0-0.69	92	Fair
Pugh Creek	1981	R1	67	Good
Owl Creek	1981	R1, RM 0-0.25	91	Fair
		R2, RM 0.25-0.55	80	Fair
		R3, RM 0.55-1.62	99	Fair
		R4, RM 1.62-1.88	117	Poor
	1997	R1, RM 0-0.3	64	Good
		R2, RM 0.3-2.1	101	Fair
Camp Creek	1981	R1	70	Good

Table 13. Spot Water Temperatures From Selected Level II Stream Surveys

Stream Name	Date	Temperature, °F (C)	Comments
White Chuck River	8/81	46 (7.8) 48 (8.9) 50 (10) 51 (10.6)	46°F—RM 11.75-12.75, between Owl Creek Campground and the Wilderness bdry 51°F—RM 0.0-1.37, from the mouth up to the confluence with Black Oak Creek
Owl Creek	8/81 7/97 8/97	60 (15.6) 54 (12.2) 57 (13.9)	
Pugh Creek	9/81	50 (10)	
Camp Creek	8/81	53 (11.7)	
Tributary 1118	9/81	52 (11.1)	
Stujack Creek	8/81 9/92	50 (10) 50 (10)	
Dead Duck Creek	9/92	44 (6.7)	

Temperature

Level II stream survey temperatures are point-in-time measurements taken with a handheld thermometer. They are taken at intervals during the day with limited utility other than being general indicators of stream temperature. The relevant information in the table is that Owl Creek may have higher temperatures than the rest of the analysis area. Recording thermographs were also used to record continuous air and water temperatures in the White Chuck River just upstream of where the White Chuck Road crosses the river, from July to September 2001 (Table 13. Spot Water Temperatures From Selected Level II Stream Surveys above). The highest water temperature recorded was 14.2 degrees Celsius, on two separate days in August. This is less than the existing standard for spawning and rearing habitat of 16 degrees Celsius. The proposed revisions to the State Water Quality Standards would amend the temperature standard to 12 degrees Celsius (7-day average maximum) for bull trout (char) habitat. The proposed standard would have been violated for seven days in 2001. Bull trout are known to use the White Chuck River.

Since there is no long-term stream temperature record for the White Chuck, it is unknown how much concern there is for bull trout in the White Chuck. There were a total of 230 hours on 25 separate days where the temperature exceeded 12 degrees Celsius, during the summer of 2001. The 12 degrees Celsius standard for bull trout is proposed as a 7-day running average of the maximum temperature. Under this scenario, the maximum 7-day average stream temperature for 2001 was greater than 12 degrees Celsius for 19 days. This occurred in three separate blocks, one four days, one 12 days, and one three days in length. This would suggest that water temperature is a source of stress on the bull trout population at least during some years.

Additional years of monitoring as well as additional stations upstream of the bridge and near the mouth of the White Chuck will help determine the extent to which stream temperatures are a concern for bull trout and other aquatic species.

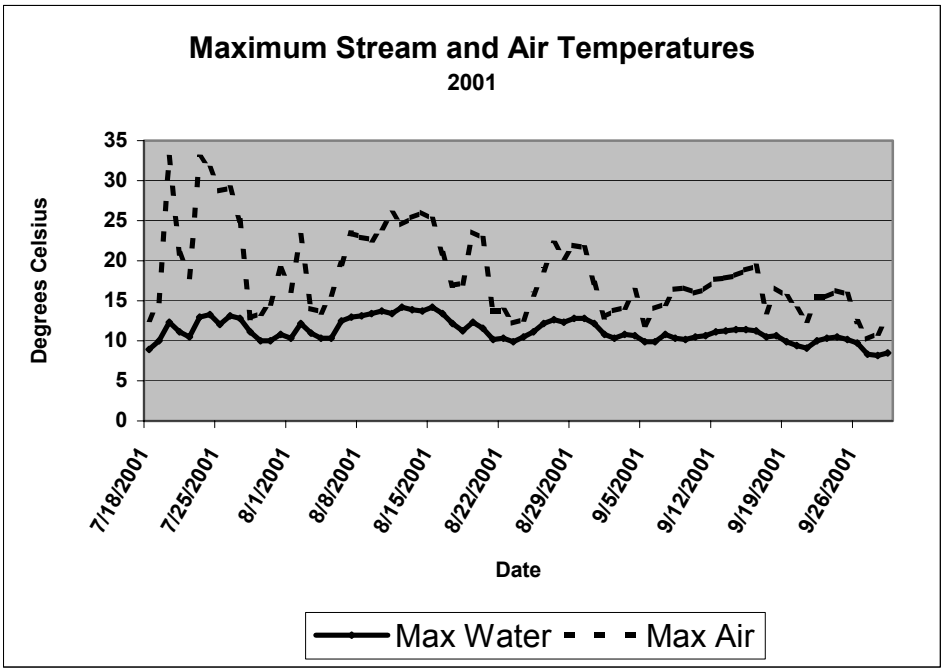


Figure 1 Max. Daily Stream, Air Temp. For The White Chuck River

Taken just upstream of the Road 23 Bridge. Temperatures were obtained using recording thermographs.

Riparian Conditions

Streamside conditions are important for water quality protection (Roni et.al. 2002). Streamside vegetation creates shade for temperature control and filters overland flow to eliminate or reduce the amount of sediment that enters the stream. Large trees eventually die or are blown over or undercut by the stream and become large woody material in the channel or on the floodplain. This large material creates channel complexity that distributes stream energy and reduces the amount of several channel erosion. The root systems of vegetation bind soil particles together, reducing bank erosion and thereby the amount of sediment introduced to streams.

The vast majority of the stream channels in the White Chuck that are bordered by forest types are composed of immature and mature vegetation. This means that there is an abundance of shade to maintain water temperature and a supply of large woody material for stream health. There are small areas where the later seral vegetation is lacking. These are areas of more recent timber harvest and generally affect smaller perennial and intermittent channels. Most notable locations are along the south-facing slopes of the White Chuck along and above Road 23 between Crystal Creek and Owl Creek. Another area is the north-facing slope around Road 2314. Overall these areas should not impair wood recruitment, however, these areas may represent small heat loads (openings where streams are exposed to the sun) that contribute to higher stream temperatures.

The Riparian Reserves structure analysis revealed there are areas along the lower White Chuck where young vegetation and highly unstable soils coincide. These areas are of heightened concern for stream bank erosion. The stream reach stability ratings from a stream survey in 1981 (Table 12 Channel Stability Results From Level II Stream Surveys) indicate poor to fair stream bank stability along the White Chuck mainstem from RM 13 downstream. Some of the tributaries (Black Oak, Stujack, and Pugh Creeks) had better stream bank stability ratings. Owl Creek surveys in 1981 and 1997 show a slight improvement over time, but stability is overall rated as fair. No additional field surveys were made of the river to verify this concern. Much of the lower bank stability appears associated with the steep inner gorge areas of the White Chuck River and Owl Creek.

Much of the sediment that does enter streams in the White Chuck River will generally be transported downstream and into the Sauk River because of high stream energy in the White Chuck. There are some depositional areas in the lower three miles of the river where gravel bars are common. Turbidity in the White Chuck is naturally high because of the glaciers in the headwaters. Highest turbidity levels are in the summer when the glaciers are actively melting.

Human Waste

The White Chuck is a popular route for climbers to access Glacier Peak. High levels of use create a sanitation concern, especially at Boulder Basin along the Sitkum Glacier route where climbers cannot find or do not use the toilet. Fecal coliform contamination of surface waters is a concern, but not a confirmed problem.

Similar concerns exist at heavily used lakes. Byrne Lake and the Kennedy Hot Springs areas are very heavily used. Compacted soils and improper disposal/removal of human wastes creates a hazard for water contamination by bacteria and nutrients.

Memorandum Of Understanding With Department of Ecology

In 2001 the Forest Service Region Six and the Washington Department of Ecology signed a Memorandum of Agreement (MOA) concerning water quality management on National Forest System Lands in Washington.

The MOA emphasizes forest management activities, including roads, as major contributors to sediment and runoff changes in watersheds. Under the MOA, the Forest Service will "stabilize" the road system within 15 years. Stabilized means there is minimal sediment from roads entering streams.

Roads are a concern in the White Chuck watershed since they are lacking maintenance and often located on unstable slopes. A recent report from the Department of Ecology (Shervey 2003) notes several road drainage problems on Roads 2300 and 2700 that need attention. Road 2700 climbs into the rain-on-snow zone and crosses steep slopes above Crystal Creek. Some portions of the road traverse benches that help trap sediment, but other areas deliver sediment directly to Crystal Creek. Road 2300 also traverses into the rain-on-snow zone and parallels the White Chuck River with direct delivery of sediment.

Lakes

The water quality of lakes was not investigated as part of this watershed analysis. There are concerns for bacteria and nutrient enrichment at heavily used lakes, and for organic enrichment from runoff across compacted soils at campsites near lakes and wetlands. Wetland hydrology may be impacted by overuse, but there has been no determination if a problem exists.

Hillslope Processes

Geology

The geologic bedrock material as well as structural features (faults, folds, etc.) within the White Chuck watershed is very characteristic of the North Cascades complex structure. Much of the original physical characteristics and appearance of the bedrock material originated from ocean floor sediments. This has been altered (primarily through heat and pressure) to various forms of metamorphic bedrock material. Sixty percent of the bedrock units within the watershed consist of three metamorphic types (*banded gneiss, schist, and orthogneiss*).

Numerous faults exist within the watersheds, (particularly within the Lower White Chuck) which have undoubtedly influenced slope stability characteristics and erosion processes in the area. The area has been extensive and repeated glaciated with both alpine and continental glaciers.

Glacier Peak

Information for the following description was obtained primarily from U.S. Geological Survey Fact Sheet 058-00 Online version 1.0.

Since the last ice age, (approximately 15,000 years ago) Glacier Peak has produced some of the largest and most explosive eruptions in the state! Glacier Peak and Mount St. Helens are the only volcanoes in Washington State that have generated such large explosive eruptions. About 13,100 years ago, Glacier Peak generated a sequence of nine tephra (molten rock fragments) eruptions within a period of less than a few hundred years. The largest ejected more than five times as much tephra than the May 18, 1980 eruption of Mount St. Helens.

Pyroclastic flows and mudflows (known as lahars) also originated from Glacier Peak. About 13,100 years ago, dozens of lahars were generated and these traveled down the White Chuck, Suiattle, and Sauk Rivers, inundating valley floors. Lahars then flowed down both the North Fork Stillaguamish and Skagit Rivers to the sea. Near the present town of Arlington, more than 60 miles downstream from Glacier Peak, lahars deposited over seven feet of sediment.

During the same eruptive period, the upper Sauk River's course was blocked in the vicinity of the present town of Darrington which redirected the rivers flow north into the Skagit River. This new river route and location continues to exist today.

About 5,900 years ago and 1,800 years ago, eruptions generated lahars that flowed down the Sauk and into the Skagit River and these extended once again to the sea. During smaller eruptions that have occurred within the last 1,800 years, lahars have extended the entire length of the White Chuck River and part way down the Suiattle.

Soils

Soil productivity within the White Chuck watershed is quite variable and corresponds with elevation, slope steepness, and parent material. Approximately 36 percent of the watershed consists of rock outcrop and talus slopes. These conditions are most prevalent within the steeper sloped, higher elevations areas (most prevalent within the Upper White Chuck subwatershed).

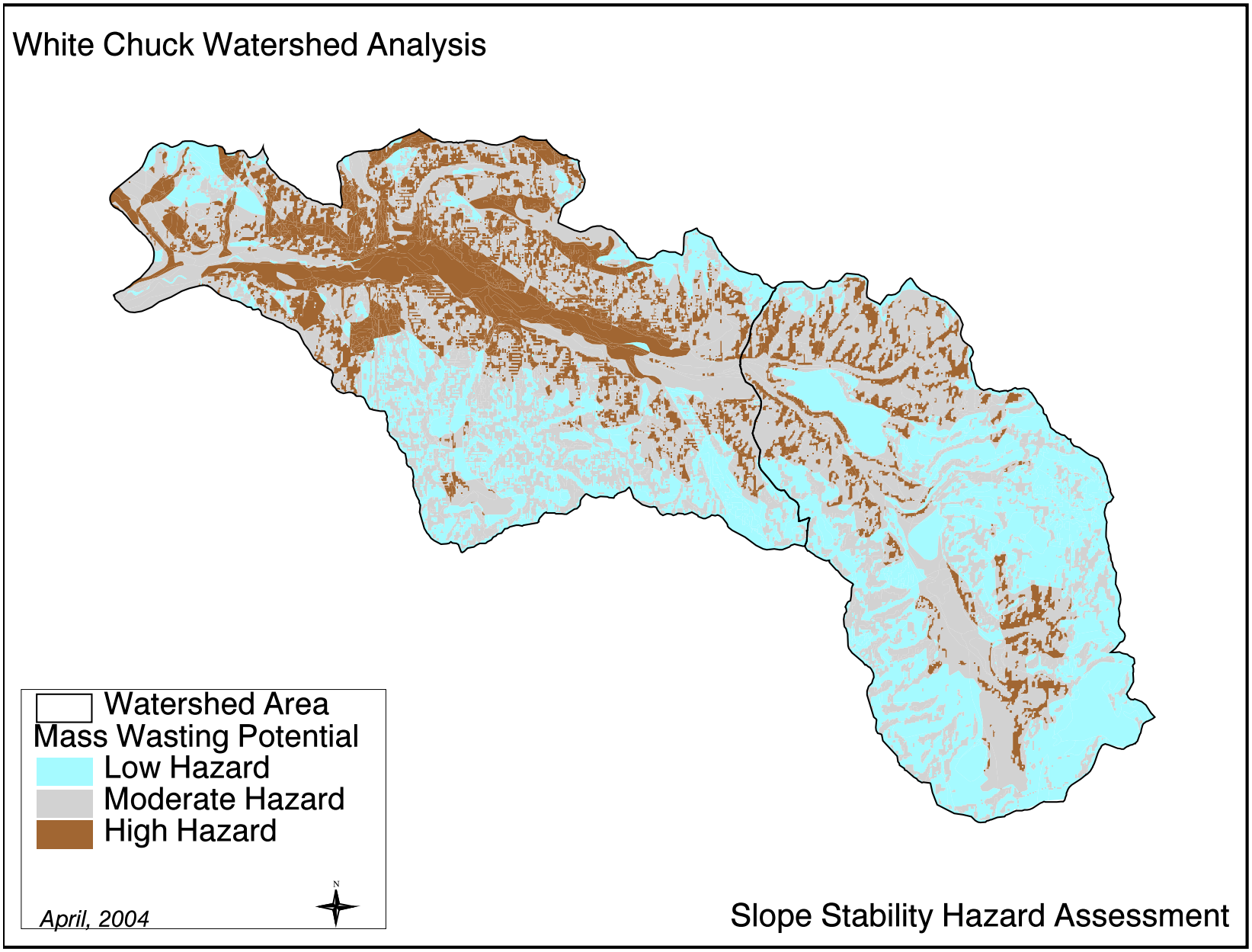
Soil development and productivity is much higher within the valley bottoms and lower toe slopes where soils have developed from material that includes pumice and ash, glacial till and drift, residuum and colluviums, and alluvium. Deposits of glacial till and interbedded glacial lacustrine materials (existing primarily within the lower valley floor) develop unique soil structural and textural characteristics that frequently influence soil drainage characteristics that can have a substantial influence on slope stability potential.

Mass Wasting

No comprehensive landslide inventory has been completed within the White Chuck watershed analysis area. The Mt. Baker-Snoqualmie National Forest (MBS) Slope Stability Model was used in order to assist in identifying areas of relative hazard potential or risk for experiencing slope failures (mass wasting) under natural conditions. The MBS model integrates six interrelated physical characteristics, using GIS (Arc/Info), for evaluation and interpretation.

The six characteristics used for the model include: bedrock geology, slope morphology, soil parent material, soil infiltration characteristics, precipitation zones, and previously identified highly unstable soils (categorized as S8/J8 highly unstable soils as defined in the Forest Plan). (Refer to Appendix C for a detailed description of model assumptions and methodology).

Figure 2 MBS Slope Stability Model for White Chuck Watershed



According to the MBS model, a total of 11,963 acres within the planning area (approximately 22 percent of the area) are considered to have a high potential for mass wasting activity. Forty-six percent of the area is considered to have a moderate risk for mass wasting with the remaining 32 percent having a low risk. The lower White Chuck (subwatershed 06) contains the highest concentration of high-risk acreage (9,442 acres), which represents approximately 31 percent of the watershed area. Approximately 10 percent (2,521 acres) of the upper White Chuck (subwatershed 05) is considered to have a high mass wasting potential.

As previously mentioned, numerous faults exist within the area, particularly the lower watershed. These fault zones can create zones of weakness within bedrock material, which may result in additional hazard conditions. The slope stability model does not currently include the risk potential associated with faults.

Areas described as S-8 or J-8 have been identified within the analysis area and are included in the acreages described as high-risk within the previous paragraph. Areas identified as J-8 are usually very steep, rocky areas that would represent extreme difficulties for reforestation. The S-8 areas are prone to landslide or mass wasting activity. No S-8 or J-8 areas have been identified within the upper White Chuck. Within the lower White Chuck, there are 1,019 acres of S-8 and 1,437 acres of J-8 identified. The majority of the S-8/J-8 identification was accomplished with the aid of aerial photography with some ground verification. Wilderness areas were not considered as high priority for this inventory work, because harvesting and road building is not allowed. Therefore, it is quite likely that S8/J8 acreage does actually exist within the upper White Chuck, but no further inventory has been accomplished within the watershed.

Land Areas have been described for this area as part of the Mt. Baker National Forest Soil Survey. The majority of the high-risk acreages are concentrated within three land area types (AM, BM, & AM/BM). However, if the high-risk acreage is reviewed in terms of the relative percentage of each land area, land area CM and DM are most significant. For example, Land Area DM has the highest percentage of that land area being designated as high risk (1,677 high risk acres/2,575 total acres for land form DM).

Based on this analysis, deep glacial till and lahar material on valley toe slopes and bottoms of major valleys represent the highest potential for soil erosion problems within this watershed.

Table 14 Mass Wasting Potential Acreage/Percentage of Land Area

Land Area	Total Acreage for Mass Wasting Potential	Rated High Percent of Total Land Area Acreage
AM	2,038	7.9
BM	2,913	39.3
AM/BM	3,141	31.3
BM/DM	1,207	32.3
CM	523	43.9
DM	1,677	65.1

AM: Primarily comprised of rock outcrop, talus slopes, alpine meadows, and perpetual snow and ice.
BM: Comprised of long steep slopes, ridges and narrow valleys.
AM/BM: Combination AM and BM
BM/DM: Combination of BM and DM
CM: Deep, unstable soils on steep toe slope and midslope drainage locations.
DM: Deep, glacial till and outwash soils on valley toe slopes and bottoms of major valleys.

Hydrology

Precipitation

Precipitation in the White Chuck River is characterized by winter snow and spring and fall rain. July and August are typically dry. Much of the watershed is high in elevation, so snow dominates the winter season, however the valley bottom from Owl and Camp Creeks downstream lies within the transitional rain and snow zone. The mouth of the White Chuck River is clearly in the rain-dominated zone, however snow can accumulate at times at the mouth. Snow persists well into June and July at the higher elevations. Annual precipitation varies from 82 inches near the mouth of the White Chuck, and 131inches at White Mountain. The average annual precipitation is 100.6 inches.

Runoff

There is no active stream gage on the White Chuck River, however there was a gage (USGS Gage Station No. 12186500) downstream of Crystal Creek that operated from January 1920 to December 1921. USGS Gage Station No. 12186000 on the Sauk River just above the confluence of the Sauk and White Chuck Rivers is active and has records dating to 1917.

The hydrograph of the White Chuck and upper Sauk Rivers would be similar, but with some distinct differences. Effects of glacier melting are much more pronounced on the White Chuck than in the Sauk, and overall, the upper Sauk River is lower in elevation. This means the White Chuck River would likely have a greater percentage of the annual flow occur in the summer months with active glacier melting. This is noticeable by the amount of glacial flour (cloudiness) of the White Chuck in the summer. Snowmelt may be a little delayed in the White Chuck compared to the upper Sauk River because of slightly higher overall elevation.

The one year of stream flow records on the White Chuck River is not a long enough to draw much general information, however the hydrograph does show that the White Chuck River is very flashy. Fall storms in 1920 and 1921 increased flows from 700 cfs to over 2500 cfs in a couple days and the recession of the floods occurred as rapidly. Rainstorms associated with snowmelt probably cause snowmelt occurring in June and July, characterized by individual spikes. Stream flow rapidly declines in July and August.

The flashy nature of the runoff correlates with the high stream density and the presence of rock outcrops and talus slopes on approximately 36 percent of the watershed. Recent glacier retreat has exposed large areas of bedrock in the upper White Chuck.

Rain-on-Snow

As mentioned above, a portion of the White Chuck River is in the transitional snow zone. This is the zone, usually described as elevations between 1500 and 3000 feet, where snow accumulates during colder winter storms. Subsequent warmer storms bring rain and wind that may completely melt the snow in this zone. These rain-on-snow storms typically produce the largest floods on rivers on the west side of the Cascades. The State of Washington Department of Natural Resources has developed five zones relative to rain-on-snow (Brunengo et al. 1992). The middle zone is the “rain-on-snow” zone. The other four zones are lowland, rain dominated, snow dominated, and highland. The only zone not represented in the White Chuck River is the lowland.

While the zone titled “rain-on-snow” most commonly transitions between snow and rain, the major storms that produce flooding are associated with freezing levels up to 7,000 feet, or more. This makes it probable that there is rain and snowmelt in both the snow-dominated and rain-on-snow zones that contribute to flooding. The White Chuck River has a relatively low amount of these zones and therefore is not as prone to rain-on-snow floods as are other watersheds with a higher proportion of these zones.

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Figure 3 Rain-on-Snow Zone

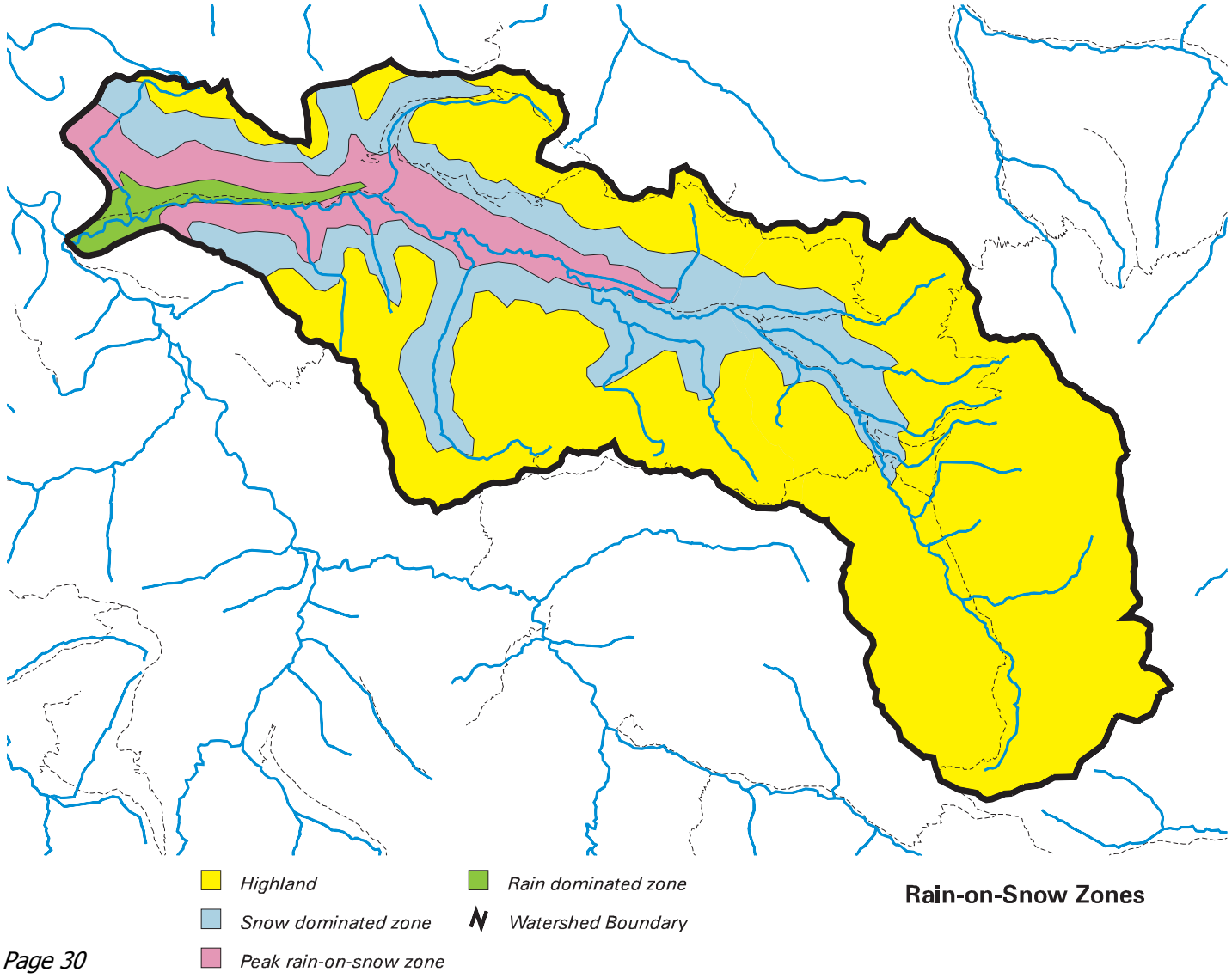


Table 15 Percent Of The White Chuck River In Rain-On-Snow Zones.

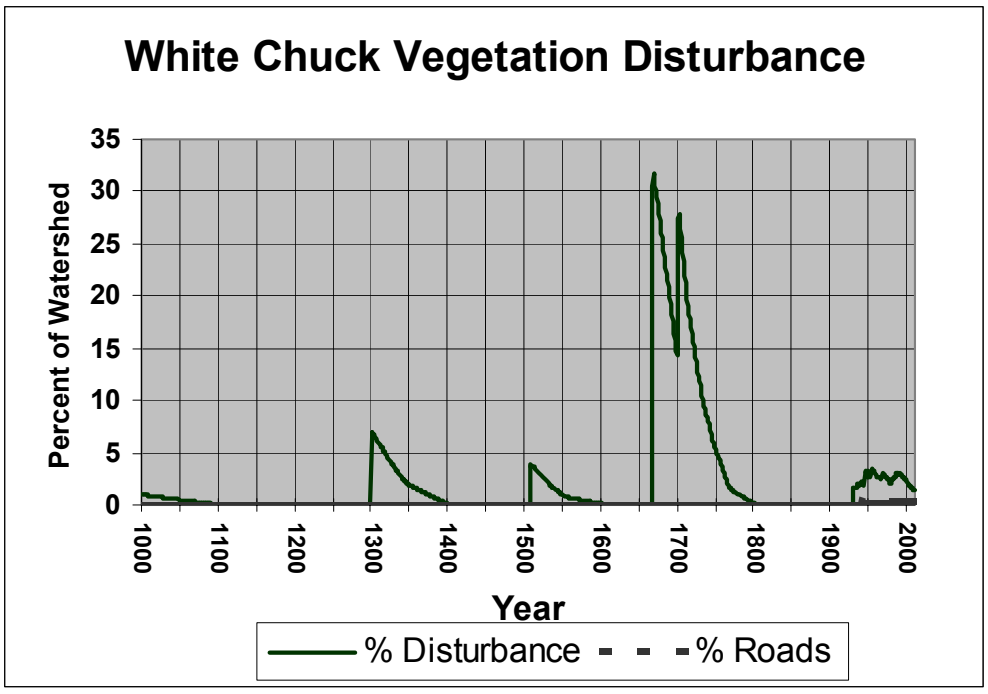
Drainage Area			
Zone	**Total White Chuck**	**Upper White Chuck**	**Lower White Chuck**
Rain Dominated	2.1	0.0	3.8
Rain-on-Snow	9.5	0.0	17.2
Snow Dominated	21.1	9.8	30.3
Highland	67.4	90.2	48.7

Vegetation Disturbance

Vegetation disturbance, as referred to in this watershed analysis, is the removal of forest canopy by fire or timber harvest and roads. Changes in a forest canopy can contribute to rain-on-snow effects by altering the processes that accumulate and melt snow (Coffin and Harr 1992). Openings in the forest canopy collect more snow during snowstorms. These same openings allow more wind movement across the snow during rain-on-snow storm events that contributes to more rapid snowmelt.

Figure 4 White Chuck Vegetation Disturbance

Results for the White Chuck River. Source: Fire history and TriOracle database of the Mt. Baker-Snoqualmie National Forest.



In this way, forest management can contribute to higher rates of snowmelt during rain-on-snow events. The vegetation disturbance level for the White Chuck watershed was modeled using fire history, timber stand (TRI Oracle), and road information. The current vegetation disturbance for the entire analysis area is very low, at 1.5 percent (Figure 4) The highest disturbance level was 30 percent from fires around 1668 and 28 percent from the 1701 burn period. In recent times the vegetation disturbance level from timber harvest and roads peaked at slightly greater than three percent in 1954.

Although there has been no timber harvest in the upper White Chuck, this area was affected by fires. Thirty-one percent of the upper White Chuck burned in the 1668 period and 24 percent in 1701. The lower White Chuck has a similar fire history, 31 percent in 1668 and again in 1701. Small fires in the 1930s and 1940s burned less than four percent of either of the drainage areas. Timber harvest in the lower White Chuck created a maximum vegetation disturbance level of six percent in 1954. The current level is three percent.

Wetlands

Wetlands are a relatively common feature in this glaciated landscape. Soils derived from glacial till and interbedded glacial lacustrine materials create highly variable soil drainage characteristics. Fine textured layers with low permeability obstruct subsurface water drainage. Wetlands result from perched water tables on the benches and low permeability areas in the valley bottoms.

The National Wetlands inventory (NWI) identifies 139 acres of wetlands in the White Chuck watershed. A large percentage of these mapped wetlands are open water lakes (e.g. Lake Byrne – 50.1 acres). A total of 95.1 acres of the NWI wetlands are lakes. Most of the non-lake wetlands are associated with the river floodplain (25.6 acres) in the lower White Chuck. The forested wetlands along the benches, such as the one where Road 2300 was re-routed in 2001, are not mapped in the NWI.

These wetlands are important for moderating runoff generated by rain-on-snow storms and retaining water within the floodplain for release later in the year. The wetlands also provide habitat for a variety of plant and animal species.

Trends for Water Quality, Hillslope Processes, Hydrology

Funding for road maintenance is not expected to increase and will likely decrease. Due to the lack of adequate road maintenance and road improvements, acceleration of road surface soil erosion as well as fill slope and cut slope erosion are expected to increase as well as slope failure. Water quality at high use recreation sites may be impacted from soil compaction, trash dumping, and improper disposal of human waste.

Terrestrial Ecosystem

Vegetation Zones

The following discussion is based largely on a classification of the vegetation that was completed on the Mt. Baker-Snoqualmie National Forest as a part of the Pacific Northwest Region Ecology Program (Henderson et al. 1992). Table 16 below and show the distribution of Vegetation Zones, or Series, within the White Chuck River analysis area, within the limits of available data. Henderson (1992) defines Vegetation Series as "taxonomic units, which are aggregates of Plant Association with the same climax indicator tree species".

Table 16 Vegetation Zones in the White Chuck River Analysis Area

Vegetation Zone	Acreage	Percent of total
Western hemlock	9,474	17
Pacific silver fir	13,237	24
Mountain hemlock	14,997	28
Subalpine fir	16	<1
Parkland	11,548	21
Alpine	5,237	10
Total analysis area acreage	54,509	

Note: there are two acres of Douglas fir vegetation zone in the analysis area. Due to the small acreage involved, this zone will not be discussed. The acres have been included in the western hemlock zone acreage total.

The White Chuck River analysis area is relatively unique insofar as six vegetation zones are represented, reflecting the great vertical relief in this area and indicating a broad array of habitat types. The lowest reaches of the watershed occupy Ecozone 9, the middle part Ecozone 10, and the far end of the watershed lies in Ecozone 11.

Ecozones are areas of land with similar environments, and these three are among the driest on the Forest (Henderson, et al. 2001). Incoming weather systems are slowed by the combination of Pugh, Spring, Red, and Black Mountains effectively creating a rain shadow that progressively intensifies toward the higher elevation reaches of the drainage. As a result, the upper limits of the vegetation zones are higher in these three ecozones than they would be in wetter areas of the Forest.

Western Hemlock Zone

Approximately 9,474 acres (17%) of the analysis area are in the western hemlock zone (Table 16). This zone is nearly continuous along the White Chuck River to approximately Pumice Creek. After that, it is patchy and extends as far as Chetwoot Meadows.

The climate in the western hemlock zone portion of the watershed is characterized as warm temperate to maritime, receiving most of its precipitation in the form of rain. The western hemlock series occurs on some of the most productive growing sites in the analysis area.

Pacific Silver Fir Zone

Approximately 13,237 acres (24%) of the analysis area are in the Pacific silver fir zone (Table 16). This zone lies above the western hemlock zone and extends far into the Crystal Creek, Pugh Creek, and Fern Creek drainages. In some areas along the White Chuck River, the Pacific silver fir zone actually drops below the western hemlock zone, probably as a response to the cool, moist conditions found along the River.

The climate in the Pacific silver fir zone is characterized as cool temperate, receiving much of its annual precipitation in the form of snow. The silver fir zone occurs on low to moderately productive sites in the watershed. Cold temperatures and soil types can limit stand growth potential in this series. Western hemlock is present in significant amounts in this zone and may in fact be the dominant species in many stands at the lower elevation limit of Pacific silver fir.

Mountain Hemlock Zone

Approximately 14,997 acres (28%) of the analysis area are in the mountain hemlock zone (Table 16). This is the largest vegetation zone in the analysis area. It occupies the area between the upper Pacific silver fir boundary and the upper limit of closed forest.

The climate in the mountain hemlock zone is characterized as cold temperate, receiving much of its annual precipitation in the form of snow. Site productivity in this zone is generally low, primarily due to soil types, long periods of cold temperatures, and a heavy, persistent snow pack.

Subalpine Fir Zone

Within the analysis area are approximately 16 acres of subalpine fir type. This zone occupies upper elevation slopes, mostly above 5500 feet elevation on drier parts of the Forest, but may occur at lower elevations if on talus or recent lava flows (Table 16). This vegetation type is typically found in the driest Ecozones and is not common on the north half of the Forest due to the greater precipitation levels here. In this part of the Forest, it is typically replaced by the mountain hemlock zone. In the analysis area, there are a few small-acreage patches between the mountain hemlock zone and the parkland zone close to the trail between Fire Creek Pass and Kennedy Creek, on the west shoulder of Glacier Peak.

Parkland Zone

Above the mountain hemlock zone the forest becomes increasingly discontinuous and the landscape appears as a mosaic of tree patches or stringers, and meadows. The vegetation is dominated by a variety of shrubs, forbs, and graminoids, as well as lakes, ponds, wetlands, rocks, and permanent snowfields. This is a transition zone between forest and non-forest and is in constant fluctuation, adjusting to the natural climatic fluctuations.

Temperature, topography, and aspect affect the location of late-melting snow patches that are important in determining the vegetation patterns in this zone. At the upper limit of the parkland zone, trees lose their erect growth habit and eventually disappear from the community altogether. This is an especially popular zone for recreation. There are approximately 11,548 acres (21% of the area) of parkland in the analysis area (Table 16).

Alpine Zone

The alpine zone occurs above the parkland zone and down slope from glaciers and snowfields, generally above 5,500 feet. In this zone, trees are absent, and the upper limits of plant life are reached. The zone is unvegetated or sparsely vegetated and consists mostly of glaciers, cliffs, or bare rock. Occasionally, very old alpine meadows are present that have persisted through multiple Little Ice Ages. There are approximately 5,237 acres of alpine zone in the analysis area, representing 10 percent of the total area (Table 16).

Plant Association Groups (PAG)

Note: The PAG model continues to undergo refinement, and the information used in this analysis is based on the model, as it existed at the time of writing.

Vegetation is the major component of the ecosystem, and one way to describe vegetation is through a classification based on potential vegetation, using the plant association as the basic unit (Henderson et al. 1992). Potential vegetation is the projected climax plant community that will occupy a site, given current climate and site conditions.

Plant association groups (Table 17) are useful for indicating the growing potential of an areas' vegetation, for getting a sense of appropriate management activities in a given area, and for identifying potential rare plant habitat.

The PAG model groups together plant associations that have similar floristic characteristics. Forest Ecologists developed the model using moisture, temperature, and topography variables. The results have been field-checked and show a high degree of accuracy; however, care should be used in interpreting any point on the ground because the model interprets broad vegetation patterns across the landscape and may be misleading on the microsite scale. Most of the plant associations grouped in each PAG are described in the Plant Association Guide for the Mt. Baker-Snoqualmie National Forest (Henderson et al. 1992) lists the PAGs in the analysis area. As a percent of the total, the largest PAG is the mountain hemlock/mesic big huckleberry. Other notable PAGs are the mountain hemlock/Alaska huckleberry, and the Pacific silver fir/dry Alaska huckleberry. Most of the PAGs are less than 6 percent of the total area, indicating a wide variety of habitat types.

Table 17 Plant Association Groups

Plant Association Group	Acreage	Percentage of Total
Western hemlock zone		
Dry salal	2900	5.3
Mesic salal-oregongrape	2891	5.3
Wild ginger-oak fern	2811	5.2
Alaska huckleberry-oxalis	485	<1
Undetermined	320	<1
Dry non-forest	53	<1
Wet non-forest	14	<1
Pacific silver fir zone		
Salal-oregongrape	122	<1
Dry alaska huckleberry	3486	6.4
Big huckleberry-beargrass	1133	2.0
Big huckleberry-white rhododendron	662	1.2
Wet al.aska huckleberry	5467	10.0
Devil's club	2280	4.2
Dry non-forest	28	<1
Other non-forest	27	<1
Wet non-forest	31	<1
Mountain hemlock zone		
Big huckleberry-false huckleberry	356	<1
Mesic big huckleberry	8557	15.7
Alaska huckleberry	5199	9.5
Wet devil's club	707	1.3
Dry non-forest	8	<1
Wet non-forest	170	<1
Subalpine fir/white rhododendron-beargrass	16	<1
Parkland	11548	21.2
Alpine	5237	9.6
Total	54,509	

Note: the PAG names are uniform for the entire Pacific Northwest Region, and may not accurately reflect the particular species found in the analysis area.

Plant Species of Concern or Interest

This section discusses the species on the Regional Forester's Sensitive Species List (USDA Forest Service 1999); Sensitive species listed by the Washington Natural Heritage Program (1997); species described in the NWFP, as amended by the ROD dated January 2001 (USDA, USDI 2001); and species regulated by law. Less than one percent of the analysis area has had systematic botanical surveys, and additional sightings beyond those already recorded are expected with further surveys.

Sensitive Species

Of the many plant species on the Regional Forester's list, 39 are documented or suspected on the MBS (MBS list dated October 1999). In the analysis area, three species have been recorded from four sites at the time of writing (Table 18). *Dryas Drummondii* is a considered a Forest Service and State Sensitive species, and *Saxifraga rivularis* and *Botrychium simplex* are State Sensitive species. In addition, there is one Forest Service Sensitive species (*Erigeron salishii*), reportedly collected from Glacier Peak, but the location information is very vague.

Table 18 Sensitive Species Recorded in the White Chuck Watershed

Species	Status	Life Form	Approximate location(s)
Dryas drummondii	Forest Service and State-listed Sensitive	Vascular plant	Pugh Mountain
Saxifraga rivularis	State-listed Sensitive	Vascular plant	North of Red Pass, and Pugh Mountain
Botrychium simplex	State-listed Sensitive	Vascular plant	Pugh Mountain
Total species = 3			**Total sites = 4**

Dryas drummondii is a low growing, yellow-flowered member of the Rose family generally found above timberline in dry, rocky areas. This particular sighting is the only one on the Forest.

Saxifraga rivularis is a tiny alpine plant that grows in rock seeps, wet meadows, and ephemeral streams. These two sightings are from among only three on the District, and seven on the Forest.

Botrychium simplex is one of the several members of the grapefern genus. It is usually less than one inch tall, and is found in mid-elevation meadows. This is the only known sighting of this species on the District, and is one of six on the Forest.

Both *Saxifraga rivularis* and *Botrychium simplex* were on the MBS Sensitive species list at one time, but were removed when information indicated their numbers and/or habitat types on National Forest land were more abundant than previously thought.

Survey/Manage Species

The Standards and Guidelines from the 1994 Record of Decision regarding Survey/Manage and Protection Buffer species were amended in January 2001, and the species list changes annually in response to species reviews. This section discusses the current situation and management direction for Survey and Manage, using the March 2003 list.

Of the nearly 300 species of fungi, bryophytes, lichens, and vascular plants described in the 2001 ROD, eight have been recorded in the analysis area from 21 sites (Table 19). Compared with other areas on the Forest, this is a high number for a small watershed. However, the number of sightings for Sensitive or Survey/Manage species in any area is largely a function of survey effort, and many of the species on this list were documented during surveys for the Meadow Mountain Trail and Circle/Crystal Trail projects, in 2001 and 2002. In the analysis area, suitable habitat is abundant for many of the Sensitive and Survey/Manage species, so the populations of these and other species of concern are likely much larger.

Table 19 Survey And Manage Species Recorded in the White Chuck Watershed

Species	Life Form	Approximate location(s)
Pseudocyphellaria rainierensis	Lichen	Two along White Chuck Trail; Meadow Mountain; Fire Creek
Sparassis crispa	Fungus	Road 24, near Black Oak Creek
Platanthera orbiculata	Vascular plant	Road 2440, ~ 1 mile east of Black Oak Creek; south of Fire Creek Pass; Meadow Mountain
Dermatocarpon luridum	Lichen	Three on Meadow Mountain
Nephroma bellum	Lichen	Four on Meadow Mountain, 2 on Crystal Lake Trail
Hypogymnia duplicata	Lichen	Along White Chuck Trail
Schistostega pennata	Moss	Two along White Chuck Trail
Botrychium montanum	Vascular plant	Crystal Lake Trail
Total species = 8		Total sites = 21

Noxious Weeds

Forest Service policy is to work with State and County weed control boards to prevent the introduction and spread of noxious weeds, and eradicate established populations. The Forest Service has adopted the State's weed list when targeting species for control.

At the time of writing, two species of noxious weeds are known to occur in the analysis area. Orange hawkweed (*Hieracium aurantiacum*) is a State Class B weed, and was first found in approximately 2000 (Washington State Noxious Weed Control Board, 2002). It is growing along the White Chuck Road, near Owl Creek. It was hand-pulled in 2001, 2002, and 2003. This mat-forming plant spreads by seed and by stolons (above-ground runners) and is notoriously difficult to remove by hand. Small fragments of the stolons that remain can generate new plants. Eradicating the hawkweed at this site is likely to be a long-term effort. Japanese knotweed (*Polygonum cuspidatum*) was found in 2002 at the west end of the analysis area at the end of a spur road. This is a rhizomatous, clumping plant that is also very difficult to eliminate by hand--even after just one season's worth of growth.

At the time of writing, an Environmental Assessment is underway to examine the noxious weed situation on a Forest-wide basis. This Assessment will examine and describe a decision on the preferred way to prevent noxious weeds and eliminate those already established. The two sites in this watershed are included in the Assessment.

Ethnobotany

There is little specific information on ethnobotanical uses of the watershed. It is known that native peoples used the area for the gathering of plants for food and medicinal purposes, and some of that use continues today (Brewer 2003). Cedar bark was collected, and still is to some degree.

Huckleberry fields were and still are important areas for collecting. The most extensive berry fields are generally found at higher elevation, such as in the mountain hemlock zone. This zone was typically kept in berry fields, as opposed to conifer trees, by a combination of deep snow pack and wildfire, which prevented tree regeneration. With wildfire suppression and a warming climate, these berry fields may become less widespread as conifers germinate and grow in their place.

Plant Habitat Diversity and Trends

This analysis area contains more high elevation habitat (i.e., subalpine fir, parkland, and alpine zones) than most areas that have undergone watershed analysis on the MBS. Consequently, the Sensitive and Survey/Manage species that show a high fidelity to upper elevations have abundant suitable habitat. Some have been reported, such as *Erigeron salishii* and *Dryas drummondii.*

The remaining old growth at the west end of the watershed is also important to those species dependent on that age class. The old growth is very fragmented around the confluence of the White Chuck River and Crystal Creek, west of Stujack Creek, and near Black Oak Creek. The remaining old growth in these areas is likely acting as refugia for species of concern, and serves as "seed sources" for the adjacent early seral stands as they mature.

Flooding in October 2003 removed riparian habitat along the entire White Chuck River, and possibly along tributary streams. As of the time of writing, there is insufficient information to determine if the loss is a significant part of the whole.

A notable characteristic of this area is the high degree of inter- and intra-watershed habitat connectivity, particularly in the upper watershed. The fragmentation of habitat the lower end of the watershed is partly mitigated by the LSOG.

Seral Stages

Seral stages for the White Chuck watershed were determined using the definitions described in Table 20. They are different for different vegetation zones because natural regeneration times and growing conditions vary from low to high elevations, and the time needed to reach a certain stage generally becomes longer with increasing elevation. Seral stages also differ by plant association group, but have been reduced to averages for this analysis. Seral stages are not reported for the parkland and subalpine fir zones because they are not significantly forested, and are not reported for the alpine zone because it does not support trees. The current seral stage situation is shown on Table 20 below, and Figure 6 Seral Stages.

Table 20 Seral Stage Definitions by Vegetation Zone

Numbers are stand ages in years.

Vegetation Zone	Early seral	Mid seral	Late seral single- story	Late seral multi-story
Western hemlock	0-22	23-180	181-407	>407
Pacific silver fir	0-40	41-306	307-507	>507
Mountain hemlock	0-40	41-306	307-507	>507

Table 21 Current Seral Stages in the White Chuck Watershed

Numbers are percent of total acreage in each vegetation zone.

Vegetation Zone	Early seral	Mid seral	Late seral single-story	Late seral multi-story
Western hemlock	5	32	55	8
Pacific silver fir	4	26	61	9
Mountain hemlock	< 1	76	8	16

Natural Range of Variability

The concept of the natural range of variability (NRV) acknowledges that ecosystems are not static and that they vary over time and space. A key assumption of this concept is that when systems are outside their natural range of variability, there is increased risk that biological diversity and ecological function may be adversely affected. The dynamic nature of ecosystems presents the need for us to consider ranges of conditions under natural disturbance regimes, rather than conditions at a single point in time. Comparisons of the current conditions to a single year in the past can be misleading because that particular year may be atypical, and because other conditions may be equally appropriate and better meet natural resource demands.

Rather than analyze NRV data within the White Chuck basin only, the team compared the situation in the analysis area with NRV data from two other watersheds. The natural variation in a single watershed is subject to extremes that can be purely random, and there are long intervals in the natural disturbance regime. Observing the variation among multiple, similar watersheds effectively increases sample size and gives greater confidence in the results. The Nooksack and Upper Skagit watersheds were chosen for comparison because they are comparable to the White Chuck River basin in terms of climate. All three watersheds occupy Ecozones 10 and 11 (Henderson et al. 1992). See Appendix B2 for a more thorough description of the methods used in this analysis.

Using multiple watersheds for comparison has precedent. This was done recently in the Interior Columbia River Basin (Hessburg et al. 1999). Data for the present analysis came from the Subregional Ecological Assessment for the Mt. Baker-Snoqualmie National Forest (USDA Forest Service 1993).

The analysis shows that stands within the White Chuck watershed generally are within or near the normal range of variability (Table 22).

Table 22 Natural Range of Variability for Seral Stages, and Current Seral Stages.

Numbers are percent of total acreage by vegetation zone.

Vegetation Zone:	Percentage Early Seral: NRV/Current	Percentage Mid-Seral: NRV/Current	Percentage Late Seral Single-Story: NRV/Current	Percentage Late Seral Multi-Story: NRV/Current
Western hemlock	0-10/5	0-34/32	8-88/55	10-70/8
Pacific silver fir	0-18/4	20-46/26	0-26/61	50-60/9
Mountain hemlock	0-8/ <1	2-44/76	0-35/8	53-80/16

The numbers reflect several things:

Most of the previously harvested timber occurred in the western hemlock and silver fir zones. In those zones though, the current amount of early seral forest is still within the normal range. Very little harvest has occurred in the mountain hemlock zone. Natural disturbance has also been minimal.

The apparently low values for late seral multi-story in all zones are a function of the definitions used. A visual inspection of the seral stage, vegetation zone, and stand year of origin maps (Figure 6 – Figure 9) show many acres of stands that originated after fires in the 1600s and 1700s. Because of the vegetation zone they occupy they are defined as late seral single-story in most cases. If the two late seral categories are added together, approximately two-thirds of the stands in both the western hemlock zone and Pacific silver fir zone are late seral.

Long-term maintenance of the range of natural variability will require human and natural disturbance, including a return of fire as a natural process.

Fire Disturbance

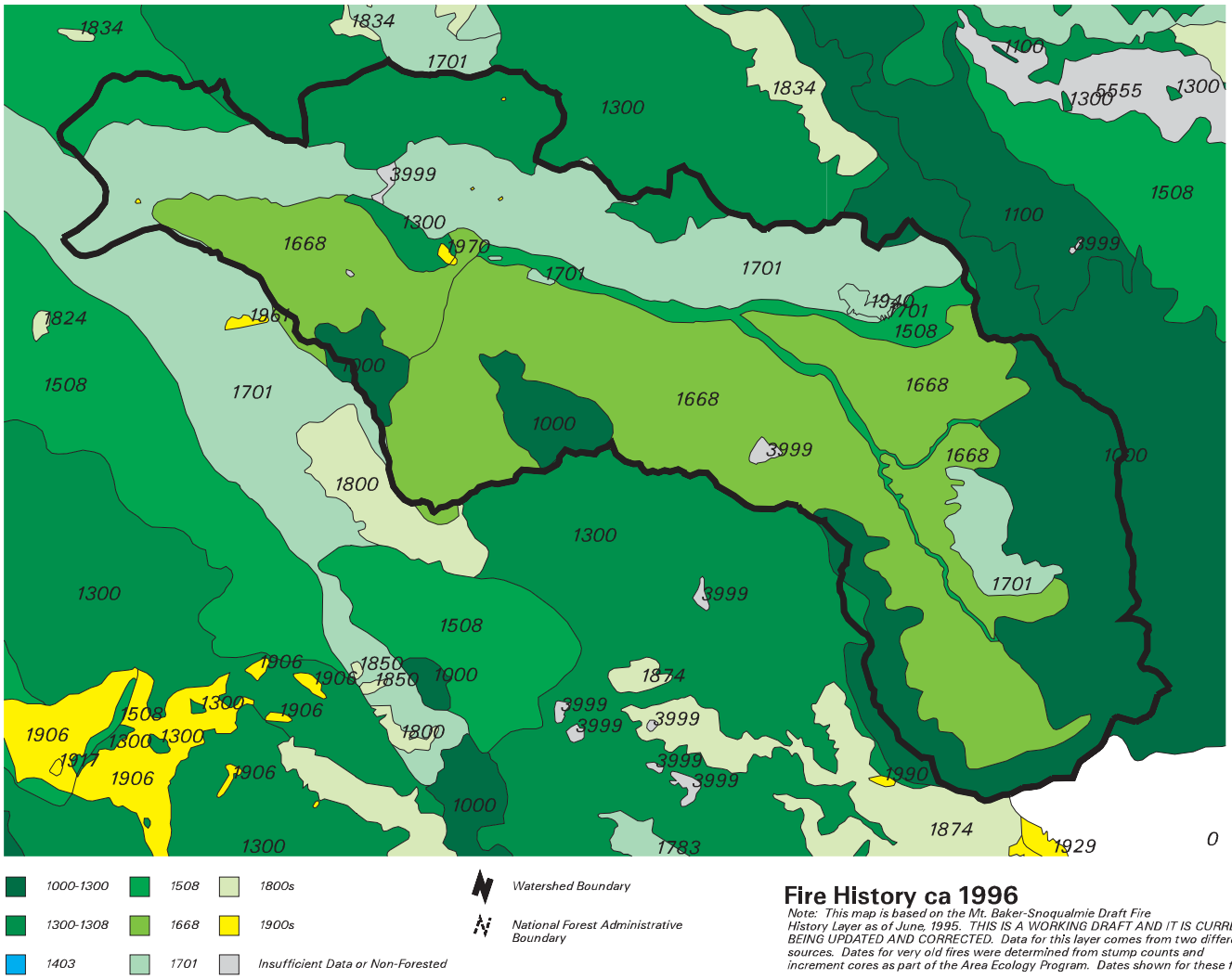
Forest structure and landscape patterns have changed significantly during the 1,000 years before European settlement. This was primarily due to the occurrence and patterns of fires. According to the Regional Ecosystem Analysis Project (REAP, Peter, 1993) and updates from Henderson (2003) there have been several fire episodes. The first in modern times occurred around 1308. This fire burned most of the White Chuck watershed and much of the Mt. Baker-Snoqualmie National Forest. About 350 years later, in 1668, much of the White Chuck watershed burned followed by a reburn of some of these areas in 1701 (see Figure 5 Fire History on page 44

Fire activity has been grouped into three periods, before 1650, which burned about 15 percent of the White Chuck area (91 fires). The second category was 1651-1920, which burned 54 percent of the area (52 fires) and the third category 1921-2002 that burned nine percent of the area (100 fires). Ice, glaciers, and non-vegetated zones in the higher elevations cover about 22 percent of the watershed. Very little fire activity occurred in the 19th and 20th centuries. All together, about 5,000 acres burned during that period. Within the last 50 years, the number of human fires has increased due to timber harvesting and recreation, but the fires have been small. Lightning fire occurrences are of limited extent and have occurred primarily at the higher elevations of the watersheds.

Large disturbances in the watershed were mainly due to the large fires. Each occurred over significant portions of the analysis area. Because of this pattern of fire occurrence, large areas have historically been converted from older forests to early seral forest in a few years time. This has undoubtedly had significant effects on fish and other wildlife species, as well as affecting the ecological processes in the watershed. Species dependent on early seral vegetation probably went through significant boom and bust cycles. The present degree of fuels buildup within the analysis area is not excessive, due in part to heavy snow pack conditions in the higher elevation.

In recent times, small fires (10-12 per season) frequently occur in association with the numerous dispersed recreation sites. An active fire management program minimizes the effects of these fires on the watersheds. Within the Riparian Reserve of the analysis area, the goal of fire management is to limit the size of all fires. Within the Late Successional Reserve land allocations, the wildfire suppression plans are to emphasize the maintenance of late successional habitat. Since 39,000 acres (71%) of the watershed is designated as Wilderness, fire management suppression activities are limited to the confine, contain or control strategies. Other uses of fire to enhance resource benefits will come when the "Glacier Peak Wilderness Fire Plan" is written and approved. This plan will include fire risks assessments and a discussion of season ending climatic events in the Glacier Peak Wilderness.

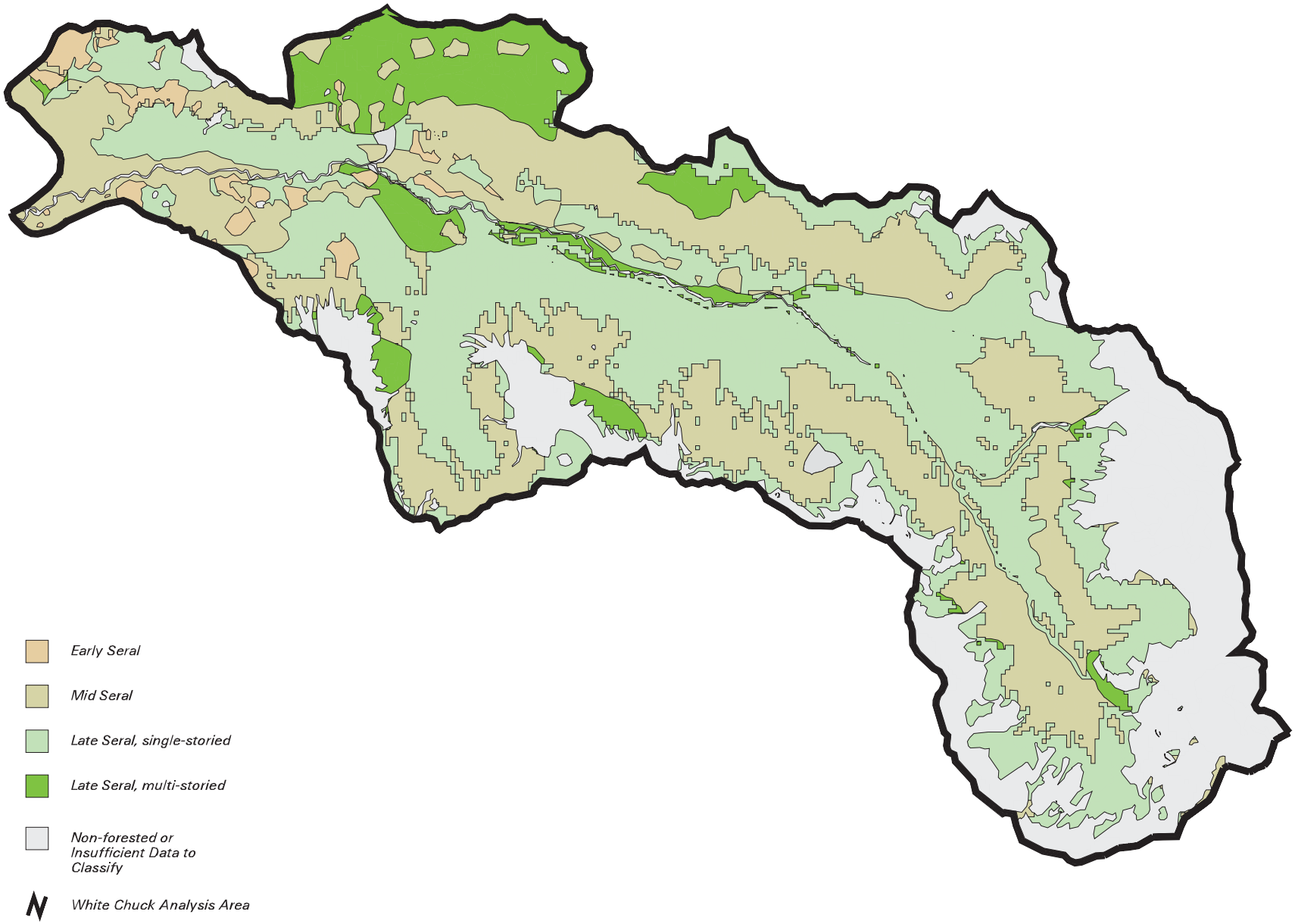
Figure 5 Fire History



Fire History ca 1996

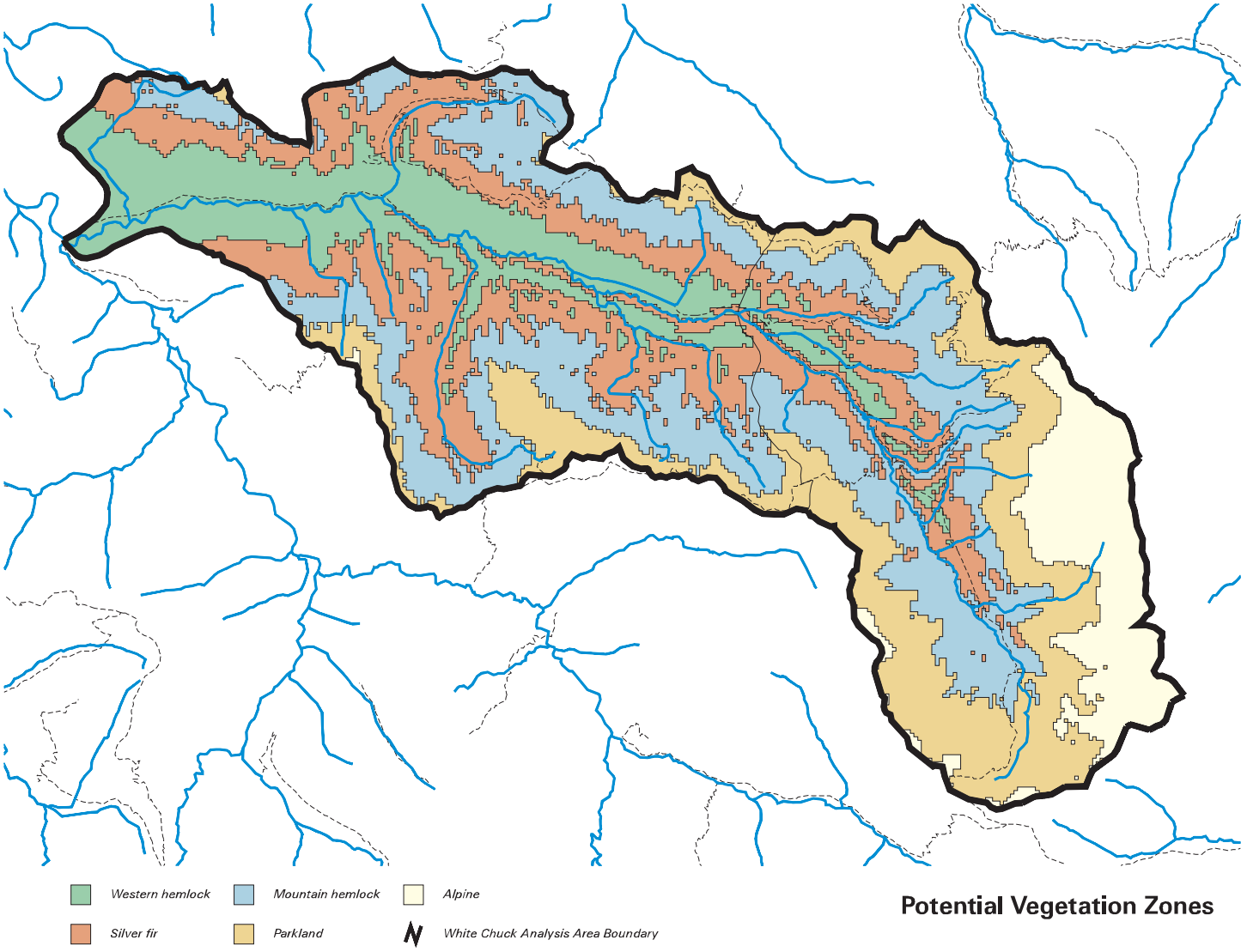
Note: This map is based on the Mt. Baker-Snoqualmie Draft Fire History Layer as of June, 1995. THIS IS A WORKING DRAFT AND IT IS CURRENTLY BEING UPDATED AND CORRECTED. Data for this layer comes from two different sources. Dates for very old fires were determined from stump counts and increment cores as part of the Area Ecology Program. Dates shown for these fires

Figure 6 Seral Stages



Seral Stages

Figure 7 Potential Vegetation Zones



Wildlife Habitat Diversity

The White Chuck River drainage provides diverse wildlife habitat, ranging from the snowfields of Glacier Peak (10,022 feet above sea-level) to the forested floodplains of the Sauk River. The White Chuck River bisects the analysis area, with much of the drainage covered with upland coniferous forests in large blocks (greater than 1,000 acres) of western hemlock and Pacific silver fir old forest habitat. The north facing slopes host wetter, cooler habitat than the south facing slopes, and the river drainage is a cold air drainage supporting silver fir at a lower elevation than the south facing slopes of Meadow Mountain and White Chuck.

Fire is the major stand replacement event occurring at historic intervals of 200 to 400 years. These intervals provide time for the development of late successional forests. Approximately 65 percent of the area is in forests that regenerated following the stand-replacing fires of 1688 and 1701. These areas provide for interior forest-dwelling species such as the northern spotted owl, marbled murrelet, marten, goshawk, Vaux's swifts, amphibians and mollusks.

Unique wildlife habitat is provided in steep cliff and rock outcrops of White Chuck Mountain, Pugh Mountain, and Glacier Peak. There are parkland, and the alpine habitat of open mixed heather and meadows located on Meadow Mountain, Lost Creek Ridge and the flanks of Glacier Peak.

Mountain lakes are found at the upper elevations along the ridge systems. The volcanic soils and rain shadow areas of the upper White Chuck drainage are the drier portions of the drainage, Ecozone 11 areas, and may be subject to a more frequent fire return interval. Evidence of younger stands or stands influenced by fire are found on the south facing slopes of Fire Mountain, and White Chuck Mountain.

Patch openings in the forest are provided by avalanche chutes and the rock and talus outcrops, associated with steep mountainous areas of White Chuck, Pugh, and Glacier Peak. Shrub fields or wetland areas provide other openings, and early seral vegetation that occurs following shifts in the river. A mix of hardwood and coniferous wetlands characterizes the valley floor and forest stands with beaver sign.

Historically, wildlife species that utilized the interior forest habitat were probably well represented. Species which utilized edge or early seral habitat would have been more abundant following stand-replacing events or were abundant in localized areas, such as riparian areas or along the interface of the forest and alpine areas.

Species at the top of the food chain such as grizzly bear or wolverine would not have been numerous even in historic times, due to the large expanses of territory to support adequate forage or prey species.

Structural Habitat Availability

Table 24 summarizes habitat conditions in the analysis area. Since wildlife species respond to structural conditions, both structural class and seral stage aggregate habitat components. Forest habitat structure generally coincides with seral conditions, with complexity greatest in the early seral and the older age classes.

Due to climatic conditions, and better growing conditions, forest stands mature earlier in the western hemlock zone than the upper elevation areas. Stands in the western hemlock zone are expected to start exhibiting older forest characteristics of snags, down wood, and large diameter trees while still a relatively young forest (80-100 years). Soft snags, multi-layer canopies and large flattop trees take time to develop, and are not expected to occur until the forest stands are 200-400 years of age.

In upper elevations of Pacific silver fir and mountain hemlock vegetation zones, 200-300 year old stands are considered mid to early seral from a ecologist's viewpoint. Many of these stands contain snags, down wood, and large diameter trees, with developing multi-layer canopies so they support wildlife species associated with mature or "old" forest. Structural Habitat Class definitions can be found in the Terrestrial Vertebrate Habitat Condition (TVHC) Model description (Vandemoer 1994) used in this analysis.

Table 23 Habitat Component Acreage by Vegetation Zone in the Analysis Area.

Key: WH Western Hemlock, PSF Pacific Silver Fire, MH Mountain Hemlock

Structure Class	Habitat Type	WH Zone	PSF Zone	MH Zone	Park land	Alpine Subalpine	Total
Open*	sparse vegetation	0	53	574	1245	10	1882
Open*	grass/forb	0	3	116	1380	75	1574
Open*	shrub	29	846	1518	383	0	2776
Open*	open sapling/ pole	624	609	340	48	0	1621
Open*	wet meadow	1	78	158	33	0	270
Hardwood	hardwood	700	0	0	0	0	700
Young forest*	closed sapling/ pole	796	494	34	0	0	1324
Young forest	closed immature	2073	481	0	0	0	2554
Young forest	open immature	0	0	3207	2081	24	5312
Mature forest	open immature	864	1467	0	0	0	2331
Mature/old	mature	145	57	0	0	0	202
Old forest	old growth	3877	8807	8141	368	0	21193
Unique*	conifer/ wetlands	82	194	64	0	0	340
Unique*	river	179	49	0	0	0	228

Structure Class	Habitat Type	WH Zone	PSF Zone	MH Zone	Park land	Alpine Subalpine	Total
Unique*	talus	0	19	200	453	70	742
Unique*	rock/glaciers	33	77	604	5445	5062	11221
Unique	lake/pond	2	0	25	96	15	138
None	Unknown/ other/ admin	69	3	16	0	0	88
	TOTAL	**9474**	**13237**	**14997**	**11532**	**5256**	**54496**

Various habitat types are not evenly distributed across the landscape (Table 23). The watershed is dominated by mature and old growth habitat in the drainage valleys.

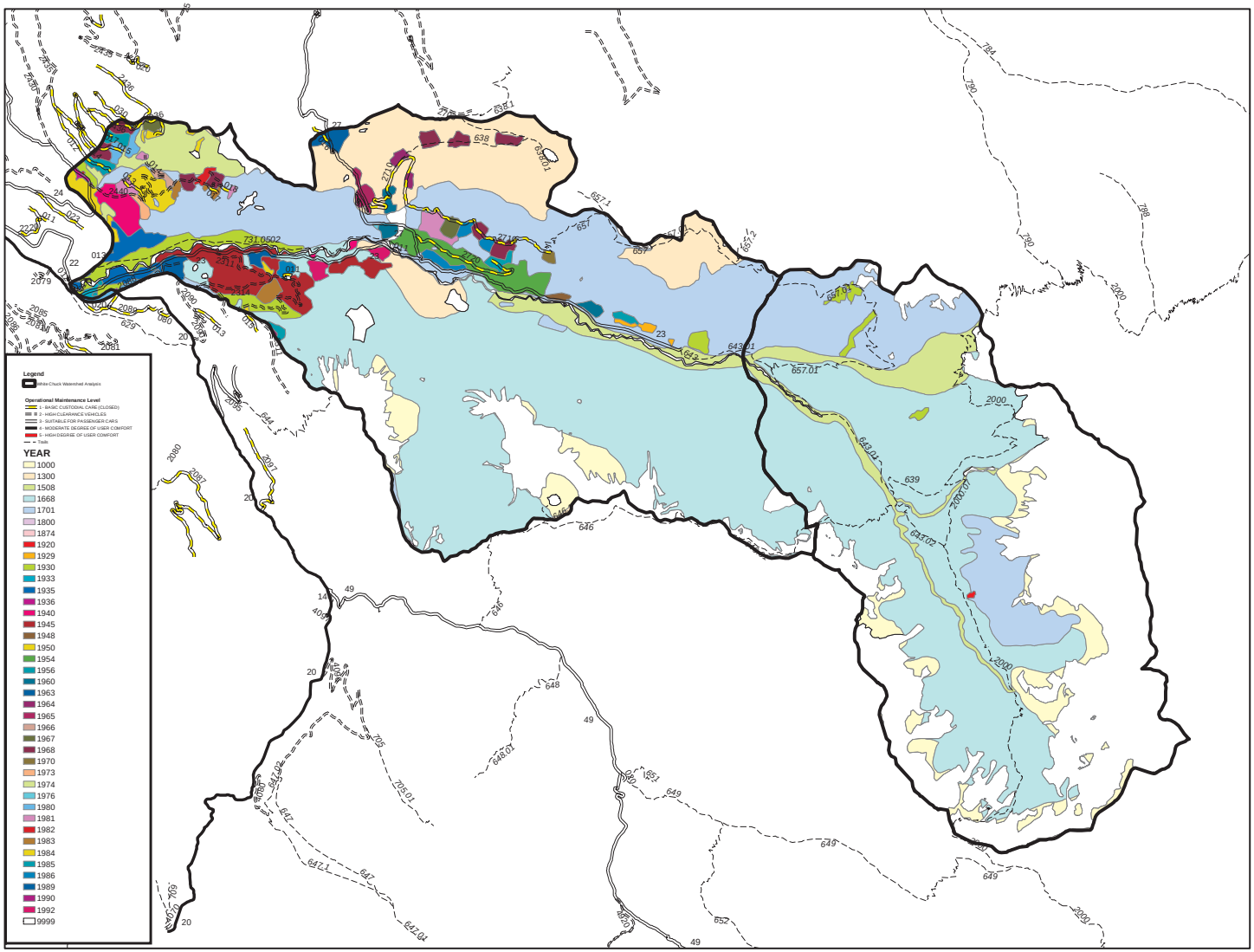
The stand year of origin map (Page 50) displays a large portion of the watershed originating after fires in the 1600 and 1700s, with some older pockets of forest dating from the 1300s to 1500s. Open and small conifer habitats occur in small size patches within a "matrix" of older forest. This habitat pattern is the result of west side climatic conditions of the North Cascades, topography, and timber harvest from the 1940s through the 1990s. Table 24 displays structural habitat class availability in the analysis area.

Table 24 Cover by Structural Habitat Classes Within the Analysis Area.

Habitat Class	Acres	Percent Cover
Open Habitat	8,130	15%
Small Conifer	9,199	17%
Large Conifer	23,726	44%
Unique/Other/ Unknown	13,439	24%
Total		100%

The old growth habitat provides for interior forest species such as the spotted owl, pine marten, and woodpecker species. Owl activity centers are found in the lower elevations of the drainage within the western hemlock and Pacific silver fir zones (Figure 9 Wildlife Habitat With Spotted Owl Circles, Page 61). The open shrub –forb habitat class is also well represented for a west-side area of the North Cascades and is expected to provide habitat for species such as the deer, grizzly and black bear, mountain goat, marmots, and a variety of small mammals and birds.

Figure 8 Forest Stand Year of Origin



Stand Year of Origin

Habitat Fragmentation

Glaciers, avalanche chutes, and different vegetation zones naturally fragment the forested habitat in the upper watershed. In the lower drainage, fragmentation also includes timber harvesting and roads. The stand year of origin map (Page 50) displays how timber harvest over the past 80 years has influenced edge and patch size of forest stands in Crystal Creek drainage and the lower portions of the White Chuck River drainage. While the drainage has some variation in forest stand age, the drainage is unique for the amount of older aged forest-acres.

In the 1920s through the 1950s, the lower elevation forest stands were harvested in large contiguous blocks of over 100 acres. In the 1960s, timber harvesting moved upslope on Pugh and White Chuck Mountain, and into the Crystal Creek drainage. Units were often 40-100 acres in size and were harvested 4-6 units in a single sale. Units were usually distributed in drainage with "leave" strips of un-harvested timber between the units. Following timber harvest, site preparation typically included burning of the logging slash before planting the sites. Huckleberry regrowth has been vigorous in some of these units, with berry and shrub habitat for bears, birds and browsing wildlife species. This stage of early seral vegetation is available until approximately 20 years of age when canopy closer results in limited sunlight to the forest floor, and a decrease in forage materials. Canopy closure at elevations with Pacific silver fir typically is later than the Western hemlock zone, and may retain a shrub component for 30-40 years following harvest.

Timber harvesting on the upper slopes of White Chuck Mountain, Meadow Mountain and Pugh Mountain continued into 1980s, with "leave" strips of timber (those portions left between previous harvested areas) cut as the adjacent plantations matured. There have been no clearcut harvests within the drainage since the mid1990s. This timber harvest pattern provided additional edge habitat and forage for deer, and earl seral wildlife species, but also opened areas for predators of interior forest species.

Habitat fragmentation in the Glacier Peak Wilderness and portions of the White Chuck drainage is also reflected by natural progression in vegetation zones, and changes in habitat due to elevation and parent material. Avalanche chutes, rock cliffs, talus slopes, and sparse vegetation in the silver fir and mountain hemlock zone provide a natural fragmentation of the landscape, and create patch-edges. Three peaks with glaciers, Glacier Peak, White Chuck Mountain and Pugh Mountain, ring the watershed, and provide islands of unique habitat within the coniferous landscape.

Habitat fragmentation influences wildlife's use of the areas, and the success of various species within the landscape. Spotted owls are associated with large habitat contiguous forest patches for successful foraging and dispersal. Fragmentation of coniferous forest used by spotted owls is thought to provide better habitat for great horned owls, and barred owls, increasing potential predation or competition.

Other species thrive within edge, or ecotonal habitat, with a variety of habitat components available. Many songbirds use edge habitat, as well as many predators that are habitat generalists.

Riparian Habitat

Vegetation mapping from the TRI/ORACLE database and the Forest Geographical Information System (GIS) shows areas within riparian reserves account for approximately 40 percent of the watershed (USDA 1999). However, field verification would likely find variations in the location and percent riparian reserve allocations.

Riparian habitat is contiguous old-aged forests in the upper watershed, with habitat in the lower watershed having been subject to more changes in age class, and impacts from roads. Within riparian reserves, the main stems of creeks and rivers tend to be naturally diverse habitat over time due to the White Chuck River system being a high-gradient system with glacier melt, debris flows providing channel movement with loss of and subsequent replacement of riparian vegetation.

Wildlife Habitat Connectivity

Habitat connectivity provides for full utilization of potential habitat and provides for successful dispersal and interactions of wildlife populations. Connectivity of habitat is a concern when the habitat occurs in patches or sizes that limit species movement, or limit utilization of habitat, or creates conditions where resident populations become isolated. Isolated populations are often more susceptible to loss from stochastic events and have little dispersal capability or immigration of individuals.

Prior to European settlement, large-scale fire disturbances and other events that limited suitable habitat could result in the local extirpation of species, but adjacent areas likely contained source areas for re-colonization. Adjacent drainages held suitable habitat that allowed for continuance of species' populations (although at lower levels) and insured re-colonization as suitable habitat was created.

Connectivity of old growth habitat within the White Chuck watershed and adjacent watersheds is high. Three of the surrounding watersheds include extensions of the Glacier Peak Wilderness, and the Lower Sauk watershed includes a portion of Late Successional Reserve to the west of the White Chuck drainage. This connectivity of habitat is highest for dispersing avian species or mammals that might use forest cover, and mammals with large home ranges that encompass the various forest associations within the drainage. Those species more closely associated with unique habitat or one of the forest habitat zones, the connectivity would be broken since the valley floors and ridge system are in different forest plant associations. Various forest zones may provide cover for dispersing animals while not providing all the elements of breeding habitat.

The connectivity of the wilderness areas is supplemented with Late Successional Old Growth (Forest Plan land designation, referred to as LSOG) in the Crystal Creek drainage (USDA Forest Service 2001). This Crystal LSOG provides an addition of 1,326 acres to be managed for late successional habitat in the Rat Trap Pass area. The Rat Trap Pass LSOG abuts Forest Plan Management Indicator Species (MIS) areas for marten and mountain goat winter habitat on the south slope of White Chuck Mountain.

These MIS areas provide for additional dispersal habitat for owls and continuity of older forest habitat.

Rat Trap Pass is the lowest elevation area on the ridge system between White Chuck Mountain and Glacier Peak, and is a one of the natural travel corridors for species moving between the Suiattle River drainage and the White Chuck River drainage.

Connectivity of other non-forest habitat areas is naturally fragmented. The mountain peaks are natural islands of alpine and parkland habitat with the ridges between peaks providing thin stringers of like habitat. Some of the connectivity of alpine habitats on White Chuck and Pugh Mountains may be influenced by road systems constructed as part of timber harvests in the vicinity. Changes in adjacent habitat, and human presence on connecting ridges are likely to influence wildlife use of the areas or movements between blocks of suitable habitat.

The White chuck WSA is a relatively unfragmented forested landscape at the lower-elevations, with breaks in the forest canopy in the parkland and high mountain peaks of rock and ice. The lower drainage has extensions of younger aged forest from previous timber harvest.

Human Disturbance

Human use of forest resources in the White Chuck drainage includes both recreational uses and commodity production within the lower White Chuck River drainage. Harvesting and road construction resulted in changes to structural wildlife habitat in the western hemlock zone, and provided recreational access into the silver-fir and mountain hemlock zones.

Human Influence on Wildlife

Disturbance to individuals or populations can influence reproductive success, cause crowding into adjacent habitats, create barriers to movement, and in some cases result in direct mortality. Human disturbance has been shown to influence reproduction and population recruitment in many bird and mammal species (Bart 1977; Fraser 1984; Laws 1973). For example, grizzly bear have abandoned den sites following human disturbance (Jonkel 1980). Most species on the National Forest show some sensitivity to human disturbance during key periods of the year, including: denning or nesting seasons; while young are being raised in the first few months after birth; and during periods of nutritional stress, such as winter.

For many species, human presence reduces the quality and quantity of otherwise suitable habitat, due to avoidance of areas adjacent to roads by the animal. Avoided or reduced use of roads used by people has been demonstrated for a variety of wildlife including elk (Lyon 1984), wolf (Mech 1988, Thiel 1985), wolverine (Ruggerio et al. 1994), black tailed deer (Perry and Overly 1976), and grizzly bear (McLellen and Shackelton 1988; Jonkel 1980). Forest carnivores behaviorally avoid some high use roads (Ruggerio et al. 1994).

Some species will use roads seasonally or during periods when the roads are not used by people. Perry and Overly (1976) reported depressed deer use of habitat within 1/2 mile of main roads. On secondary roads, deer use appeared depressed within 1/8 mile of roads. On primitive roads, deer showed an upward trend in use rates with increasing distance from roads. At 0.25 mile away, deer use was at or above control levels.

Information pertaining to trail avoidance has been less studied and is less understood (McLellan and Hovey 2001). Trails are smaller, have shorter site distances, and generally do not entail use of motorized equipment. These factors tend to ameliorate effects on these species. However, avoidance of people on foot has been documented. In one study, people afoot were found to be more disturbing to wintering deer than snowmobiles (Freddy, D.J., W.B. Brounaugh, and M.C. Fowler 1986). Studies with bald eagles have also found that people afoot may elicit more response from eagles than vehicles do (Stalmaster, M. and J.R. Newman 1978, Stalmaster, M., and J.R. Newman 1978). Mountain goat apparently avoids some areas where trail use by hunters is heavy (Johnson 1983).

Grizzly bear have been observed to avoid large groups of people on trails (USDA 1985), but may not always avoid these areas. In Montana, the mean distance from trails to radio-collared bear was roughly 0.5 miles (Kasworm and Manley 1985).

Traffic patterns also affect avoidance behavior. Wolves have been observed using roads during winter, but not during summer periods (Ream and Mattson 1982). Grizzly bear use of habitat adjacent to campsites was inversely related to human use of the site (Gunther and Renkin 1985). Schallenberger and Jonkel (1980) found bears to use habitats closer to low and moderate use trails than high use trails. Human use of roads and trails can be ameliorated by both topography and vegetation (Lyon, J.L. 1993, and Edge and Marcum 1984).

Roads and trails provide increased accessibility into habitat, increasing these species' vulnerability to legal and illegal harvest. While fishers are generally tolerant of moderate levels of human activities (at least when not denning), they are highly susceptible to trapping effort (Hienenmeyer and Jones 1994). Areas with high road densities accessing fisher habitat can increase a sub-population's risk of over-harvest.

Mortality of Selkirk and Cabinet-Yak grizzly bears with telemetry collars were all from poaching, preventing population growth and recovery. Poaching animals from the Church Mountain goatherd has been documented, and may have limited population growth rates (Wright 1977). In the White Chuck Watershed, the combination of poaching and crippling loss associated with goat hunting may be nearly 30 percent over the number of goats legally harvested (Johnson 1983).

Direct relationships have been documented between recreation levels and the incidence of human/bear encounters. As recreational use increased, so have adverse human/bear encounters in the Yellowstone and northern Continental Divide ecosystems (Servheen 1997, USDI 1997a).

Some species sensitive to human disturbance require large areas where disturbance is minimal. Wolves tend to locate dens and rendezvous sites away from human activities (Jimenez, M.D., and R.R. Ream. 1995). Draft wolf guidelines include maintaining human disturbance 1.5 miles from den and rendezvous sites (Mech 1988).

Jimenez, M.D., and R.R. Ream. 1995 reported on telemetry and tracking studies of wolves in Montana where wolves frequently used roads, often at night, to follow deer. Wolverine management incorporates suggestions on road densities to one mi./mi. sq. (Ruggerio et al. 1994), as does fisher management recommendations in areas where trapping occurs for this or other species (Heinemeyer and Jones 1994). Road densities are reviewed by sub-drainages with project development

Human Disturbance Within the White Chuck Watershed

Recreational activities are potential impacts to wildlife use in the White Chuck drainage, since the area is a popular hiking, climbing, and backpacking destination, especially during the summer months. Road and trail access within the watershed is limited, but roads and trails access key habitat areas during nesting, denning, or breeding periods. Human use can reduce the amount of area effectively used by wildlife, and contribute to declines in some populations.

The degree to which human activities influence wildlife populations varies with a multitude of factors. These factors include:

- The species individuals and their exposure to long-term disturbances;
- Population demographics;
- Landscape and vegetation condition;
- Topography;
- Type and frequency of road and trail use; and
- Hunting regulations.

Species suspected of being most influenced by human uses in the White Chuck are those species that are hunted or were hunted or trapped in the recent past. This includes: bear, deer, cougar, bobcat, beaver, marten, fisher, coyote, grouse, band-tailed pigeon, and past hunting of wolf and mountain goat.

Hunting of species may make the animals more wary of recreational users that are not hunters, but are within the home range of the species. An example is the potential dispersal of mountain goats from summer use areas when mountain climbers are present. Other species in the White Chuck that may have been influenced by humans, are those species associated with certain seral stages of the forest vegetation.

Changes in structure of habitat such as the shift in older forest to young seral stages from timber harvest would shift habitat from providing for the spotted owl to early forest stage species such as deer or certain neotropical songbirds. Barred owls may be more adept are using mixed conifer and hardwoods than spotted owls.

Infrastructure Influence on Wildlife Habitat Within the White Chuck

There are no residential homes or commercial campgrounds within the White Chuck River analysis area, but there are some dispersed campsites. The highest human influence occurs seasonally and is immediately adjacent to road and trail systems. Forest Service Road #23 has been a major portal to the wilderness and popular climbing route. During the months of May and October, Road #23 and the major trails were considered “high use”. Recreationists use the area in late fall for hunting, and winter cross-country skiing or snowmobiling.

Forest Service Road #27 connects the Suiattle River drainage with the White Chuck and is used administratively for fire patrol, stand management, and access to the trail system into Crystal Lake and Meadow Mountain. The lower White Chuck drainage is within a matrix land allocation. The current road system (from previous timber harvest) functions as access to future management options. During the intervals of 20-40 years between forest stand treatments, many of the roads were put in storage (known as Maintenance Level 1--closed to vehicles).

Forest Service Road #23 is within portions of the White Chuck riparian reserves in the lower elevations. At the confluence of the White Chuck River and the Sauk River, there is a boat launch, and dispersed camping area that receive high use by the kayaking, rafting, picnicking, camping and fishing public. The dispersed camping sites and road/trail systems along the major drainages result in a zone of moderate to high human influence in the valley bottoms and within major riparian areas. This may limit the use of local riparian areas by some wildlife species sensitive to human use.

The MBS Forest Plan recommended a road density of not more than an average of two miles per square mile for areas with scenic foreground and middle ground. U.S. Fish and Wildlife Service (1994) has recommended a goal for open road densities of one mile per square mile or less in grizzly bear recovery zones.

The White Chuck Watershed Analysis Area has a range of 0.3 to 0.6 miles per square miles of open road as displayed on Table 25 Current Open Road Densities Within the Analysis Area. This drainage has limited road mileage and open road density and all of the 6th field watersheds are well below the suggested open road densities for even the most sensitive species.

Table 25 Current Open Road Densities Within the Analysis Area

Sixth Field Watershed	Miles Of Open Road	Miles of Road/ Square Mile
HUC5 (38 Square Miles) 170005	**0**	**0**
HUC6 (47 Square Miles) 170006	**29**	**0.6**
Total (85 Square Miles)	**29**	**0.3**

Refer to Table 29 Road Miles by Maintenance Levels on page 83

Road Density Classes
Road Maintenance Level 1=No vehicle use
Road Maintenance Level 2=Low vehicle use
Road Maintenance Level 3=Moderate to high vehicle use (high use on mainline and trailhead access roads)
Road Maintenance Level 4/5=High vehicle use

Roads influence how wildlife species use an area. What that influence is depends on a multitude of factors: road open or closed, high velocity or low speed, width of open space, etc. Road influences includes direct mortality from interaction of wildlife with vehicles, access the roads provide for legal or illegal take, noise, dust, other species competition may limit wildlife use along road corridors. Roads may also interfere with some species travel or migration route. Wildlife may also take advantage of roads for travel corridors, bedding, foraging and hunting areas, especially if roads are closed. Green-up along roads can also be attractive to some wildlife species. For some species areas away from roads, helps limit the negative contacts from humans. Paved roads with high vehicle traffic and higher speeds (above 35 miles/hr.) are likely to have more incidents of road kill than gravel roads. There is less than one mile of paved road in the White Chuck watershed, but gravel roads can also influence species dispersal or movements within suitable habitat. The lack of cover on the road may provide a predation zone for some wildlife species, a hazard zone for some species and an opportunity for other species. Roads may also make some species more vulnerable to excessive harvest or illegal take where security habitat is lacking. Security habitat, or areas away from open roads comprises 76 percent of HUC 6, which is 87 percent of the total WSA area acreage.

Key Wildlife Species of Concern

The White Chuck drainage hosts a variety of wildlife species. Due to the presence of numerous species, key wildlife species were identified for description of habitat and discussion of watershed issues and questions. Key species for the White Chuck drainage include the northern spotted owl and marbled murrelet for focus on late and old growth forests, and the grizzly bear and mountain goat for focus on unique habitats and interactions with the recreating public.

Northern Spotted Owl

The Northern spotted owl is a federally listed threatened species (USDI, 1990). Habitat used by this species includes low-elevation old growth forest stands for nesting and foraging, large conifer (mature) stands for foraging, and small conifer stands which can be used for dispersal. This species occurs primarily within the western hemlock and silver fir vegetation zones. Currently, available nesting habitat is approximately 13,750 acres, concentrated in the Glacier Peak Wilderness, Crystal Creek, and Pugh Creek drainages. Surveys within the analysis area conducted between 1978 and 1996, have located five northern spotted owls activity centers (Figure 9 Wildlife Habitat With Spotted Owl Circles). Roughly, 40 percent of the nesting habitat has been surveyed.

Northern spotted owls home ranges average 4,300 acres, but can exceed 6,000 acres per pair in the Western Washington Province. Large home ranges are often associated with fragmented habitat areas, and are suspected to be a result of lesser prey base availability in the northern part of the owls' geographic range. Smaller home ranges and a higher density of owl circles are often found in contiguous suitable habitat and areas with a high density of prey items (fragmented or contiguous). Owl circles in the basin are found in Crystal Creek, and along the White Chuck River, and are likely to be a reflection of not only suitable habitat, but also of past survey efforts. Much of the south side of the White Chuck River has not been surveyed for spotted owls due to no proposed projects in the area that would trigger surveys, no previous habitat conservation designation, and the difficulty of access (limited roads or trails). Currently, there are approximately 13,750 acres of nesting/roosting habitat and another 1,466 acres of foraging habitat and 3,200 acres that provides suitable conditions for dispersal.

Old growth stands within the analysis area primarily originated from fires in 1668 and 1701 (see Figure 5 Fire History on page 44). The resulting 300-year and older forest stands have high quality nesting habitat conditions for northern spotted owls. Old growth western hemlock, Douglas-fir and cedar occur in these stands and provide important nesting habitat of larger diameter trees with cavities.

Old growth occurs within the watershed in patch sizes ranging from 600 to over 1,000 acres. Overall, nesting habitat is lightly fragmented from timber harvest occurring over the past 70 years. The largest block of nesting habitat occurs in the Glacier Peak Wilderness with other large old growth blocks occurring in Crystal Creek and Pugh Creek drainages. The connectivity with suitable nesting habitat in the Suiattle River to the north and the N.F. Sauk River to the South provides for owl recruitment and dispersal in the White Chuck river drainage.

There are several suspected factors limiting northern spotted owls in the watershed. The watershed is located in the northern edge of the spotted owl range and likely has a limited prey base. Only seventeen percent of drainage is in the western hemlock zone and 52 percent of that in mature and old forests, which means nine percent of the watershed has low elevation, old forest nesting habitat.

Another factor that may impact spotted owl use of the area is increased competition with barred owls. Barred owl populations are noted as increasing in numbers across the range of the northern spotted owl (Kelly, E.G. 2001). Barred owl detections have been made within one-half mile of most of the spotted owl activity centers. Barred owls use much of the same habitat as northern spotted owls for nesting, but also occupy mixed hardwood and conifer stands along riparian areas for roosting and foraging. (Kelly, E.G. 2001)

Sites within the White Chuck Watershed with barred owls include: Dead Duck Creek, Rat Trap Pass, Crystal Creek, White Chuck trail near Fire Creek, and in the Kennedy Hot Springs area. Barred owls have been reported along Forest Service Road 23, and near Stujack Creek.

Critical Habitat, Northern Spotted Owl

The White Chuck watershed includes critical habitat in the Crystal Creek drainage as designated in the Federal Register (USDI 1992a). There is a Late Successional Old growth (LSOG) area from the NWFP, in the Rat Trap Pass and Crystal Creek drainage. This LSOG provides additional habitat for spotted owl dispersal, and connectivity of critical spotted owl habitat of the Suiattle River drainage with habitat in the Glacier Peak Wilderness of the White Chuck River drainage. There are 1,326 acres in the LSOG, with 1,130 acres in suitable forest associations and age classes for spotted owl nesting. There are an additional 200 acres of dispersal habitat.

Table 26 Northern Spotted Owl Reproductive Status

Activity Center	1978	1979	1982	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	2001	2002	2003
22903 Black Oak	**PR**		**PR**	**S**	**PR**	**PR**	**S**												
22524 Crystal Cr.	**S**	**S***	**PR**				**S**		**PR**	**PR**							**PS**	**S**	
22303 Dead Duck										**PR**									
27503 Fire Cr.	**S**						**N**			**S**				**PR**	**PR**	**?**			**PR**
20612 Kennedy	**PR**		**PR**	**?**	**S**	**PR**	**PR**										**N**	**N**	

(within the analysis area) Key: S= Single Owl, PF= Reproductive Pair, Fledglings observed PR= Pair of owls, PS= Pair of Owls suspected. N= Surveyed, no STOC detections

*Information is from various field trips and not to regional protocol.

Figure 9 Wildlife Habitat With Spotted Owl Circles

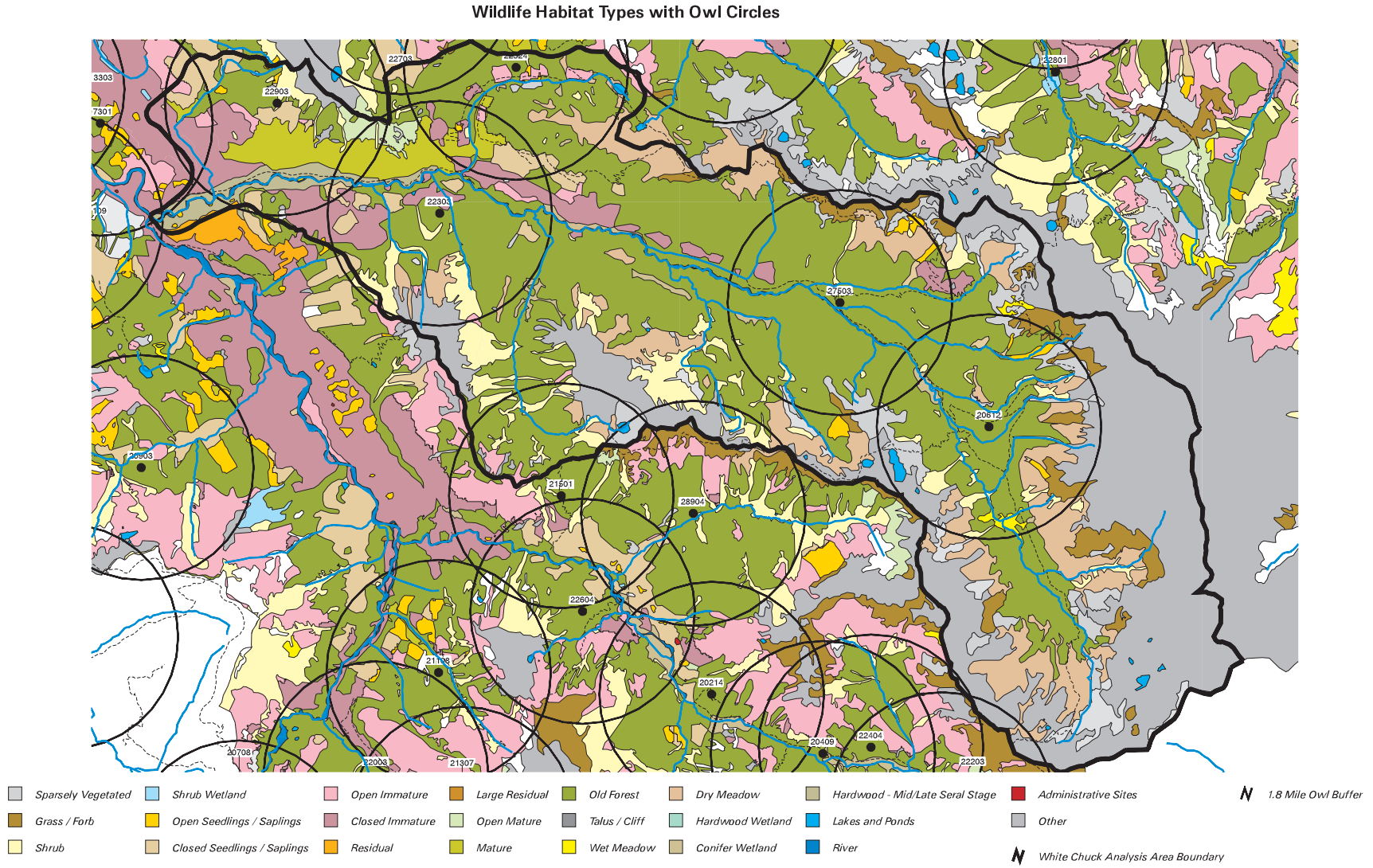
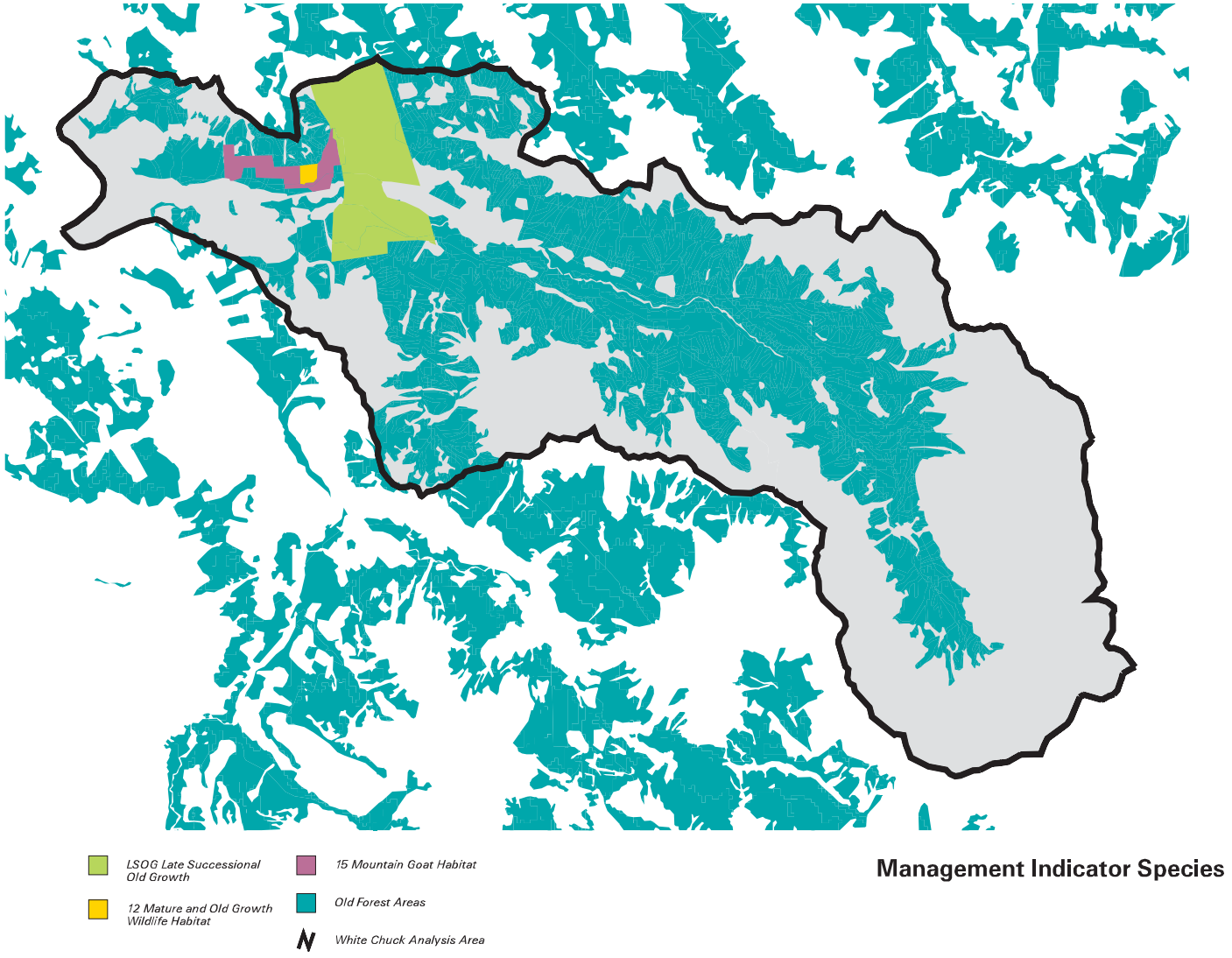


Figure 10 Late Successional Old Growth/ Management Indicator Species



Marbled Murrelet

The marbled murrelet is a seabird that uses inland forest sites for semi-colonial nesting from Alaska south to northern California (Marshall 1988). This bird, first reported on the Forest in 1909 in the Nooksack River basin, was listed as a federally threatened species in September 1992 (USDI 1992c).

The first nest discovered in the State was located in the lower South Fork Stillaguamish River watershed (Hamer and Cummins, 1991). Murrelets nesting on the National Forest are believed to originate from marine environments within Puget Sound. These waters are estimated to support one third of the State's population, or between 1,254 to 2,310 breeding-pairs (Marshall 1988).

Historical information pertaining to murrelet abundance is largely unavailable, although in the early 1900s they were described as common or abundant in areas currently supporting very low numbers (PSG 1993). A monitoring effort in British Columbia yielded an estimated 40 percent decline in observed murrelets between 1982 and 1992 (Kelson and Manley 1993). Another estimate suggests an 80 percent decline in suitable nesting habitat availability over the past 200 years (Hamer and Cummins, 1991).

In 1992, the Forest Service estimated a 13 percent decline in habitat on the north half of the MBS over the past 20 years (USDA 1992). Reductions in nest habitat, susceptibility to perturbations in marine environments, and low recruitment rates were reasons reported for listing the species as threatened in 1992.

While this bird has been detected inland as far as 52.25 miles from Puget Sound, most (94 percent) have been reported within 40 miles of the Sound. The north half of the MBS contains over 85 percent of the murrelet detections on the Forest, and over 50 percent of the available nesting habitat. The White Chuck analysis area is within 35 to over 50 miles from saltwater (ROD Zones 1 and 2), and is at the more easterly extent of suspected murrelet nesting habitat.

The analysis area contains approximately 13,750 acres of potential nesting habitat (Zones 1 and 2 (see Figure 10 on page 62) within the western hemlock and Pacific silver fir zones, but only about 10 percent of the suitable nesting habitat is within 40 miles of saltwater. Suitable habitat close to saltwater provides a short round trip for adult birds feeding juveniles, and less distance for a fledgling to cover in the initial flight from nest to saltwater. Therefore, habitat closer to saltwater may provide some advantage to successfully recruitment of young into the population.

The White Chuck analysis area has approximately 45 percent of the potential nesting habitat located 40-45 miles from saltwater, and the remaining 45 percent of the total nesting habitat, is 45-50 miles from salt water. These areas may be marginal to the successful recruitment of murrelet chicks to the population due to the distance from saltwater.

Murrelet activity on the Mt. Baker-Snoqualmie National Forest has been detected in forest stands containing large old growth trees of the western hemlock and silver fir vegetation zones, generally below 3,200 feet. Low elevation old-growth forests provide the large lateral branches for nesting platforms, overhead protection, and ease of entry into the canopy for the adult birds. Suitable nest platforms may occur in younger trees infected with dwarf mistletoe. Since the nests are not constructed, a substrate of moss or lichen has been common to the nests found.

Another suspected characteristic of murrelet habitat is protection from wind. Since the young are left on the nest shortly after hatching, protected areas from wind may result in higher survival of the chicks. The White Chuck River drainage is impacted by storms, but prevailing weather patterns are usually from the southwest, with protection from the ridge systems of Forgotten Mountain, and Pugh Mountain.

Within the old forest acreage, the western hemlock zone best fits the characteristics of forest stands located below 3,200 feet in elevation, old forest stands with large lateral branches for platforms, moss or lichen covered branches, and protection from wind. The western hemlock zone provides approximately 4900 acres of the older forests (combined western hemlock and Pacific silver fir) or about 36 percent of the total old forest.

Nesting occurs from April through September each year. Since murrelets have been observed flying inland to forested areas at other times than during the breeding season, it is thought that these forests may also be important for roosting (Pacific Seabird Group, 1993). There are approximately 2,200 acres of recruitment habitat for murrelets; recruitment habitat is considered stands in the open mature age class that are expected to provide the next suitable habitat as the stands develop over time.

There are few known murrelet activity sites in the White Chuck drainage. This is likely due to limited survey efforts, since there have been few proposed projects that would remove suitable nesting habitat since the listing of the murrelet in 1992. There were detections of murrelet vocalizations, and fly-over occurrences along the White Chuck River as far inland as lower Crystal Creek, 41 miles in-land (Forest Service files). Limiting factors for murrelets may include amount of suitable nesting habitat and distance from saltwater.

The White Chuck River drainage provides limited amounts of suitable habitat in the lower elevation habitat of less than 3,500 feet. There is only 17.4 percent of drainage in western hemlock forest association and 36 percent of that in old growth forests. The distance inland from salt water may also limit the numbers of murrelets using the watershed since 75 percent of the drainage is beyond 40 miles from saltwater.

Small patch size of suitable nesting habitat is often cited as a concern for the potential nest predation, a primary source of nesting failure in murrelets (USDI 1997b). Suitable habitat in the White Chuck River drainage is most fragmented in the areas thought to be most suitable for murrelets–in the lower White Chuck River drainage. There are relatively large patches of suitable habitat (>1000 acres) in the upper White Chuck River watershed, but much of this is at the greater than 40 miles inland from salt water. Increased recreational use with accompanying food sources may encourage populations of egg or nestling predator birds such as crows and Stellar jays. These birds are opportunists, and are attracted to food scraps left by recreationists. Some biologists are concerned that loud noise may disrupt breeding success by flushing the incubating adults off the nest or by interrupting the feeding of young.

Critical Habitat, Marbled Murrelet

The White Chuck watershed includes critical habitat as designated in the Federal Register Vol. 61, No. 102/Friday, May 24, 1996/Rules and Regulations (USDI, 1992c and USDI, 1996). Rat Trap Pass and Crystal Creek drainage is designated as Late Successional Old growth (LSOG). This area is suitable for spotted owl dispersal, and provides connectivity of suitable spotted owl habitats between the Suiattle River drainage (Late Successional Reserve) and the Glacier Peak Wilderness in the White Chuck River drainage. Critical habitat is 1,326 acres and 1,130 acres are in suitable forest associations and age classes for potential murrelet nesting habitat.

Within the White Chuck analysis area, there are additional older forest management areas in Management Indicator Species (MIS) habitat for mountain goats and marten, semi-primitive non-motorized areas, and wilderness areas. These areas provide additional 2,000 acres of old growth forest below 3,200 feet elevation above sea level, which provide potential nesting habitat in the elevations where most murrelet detections have been recorded. Most of the wilderness acres are located 40 to more than 50 miles from saltwater, and are above 3,200 feet in elevation.

Grizzly Bear

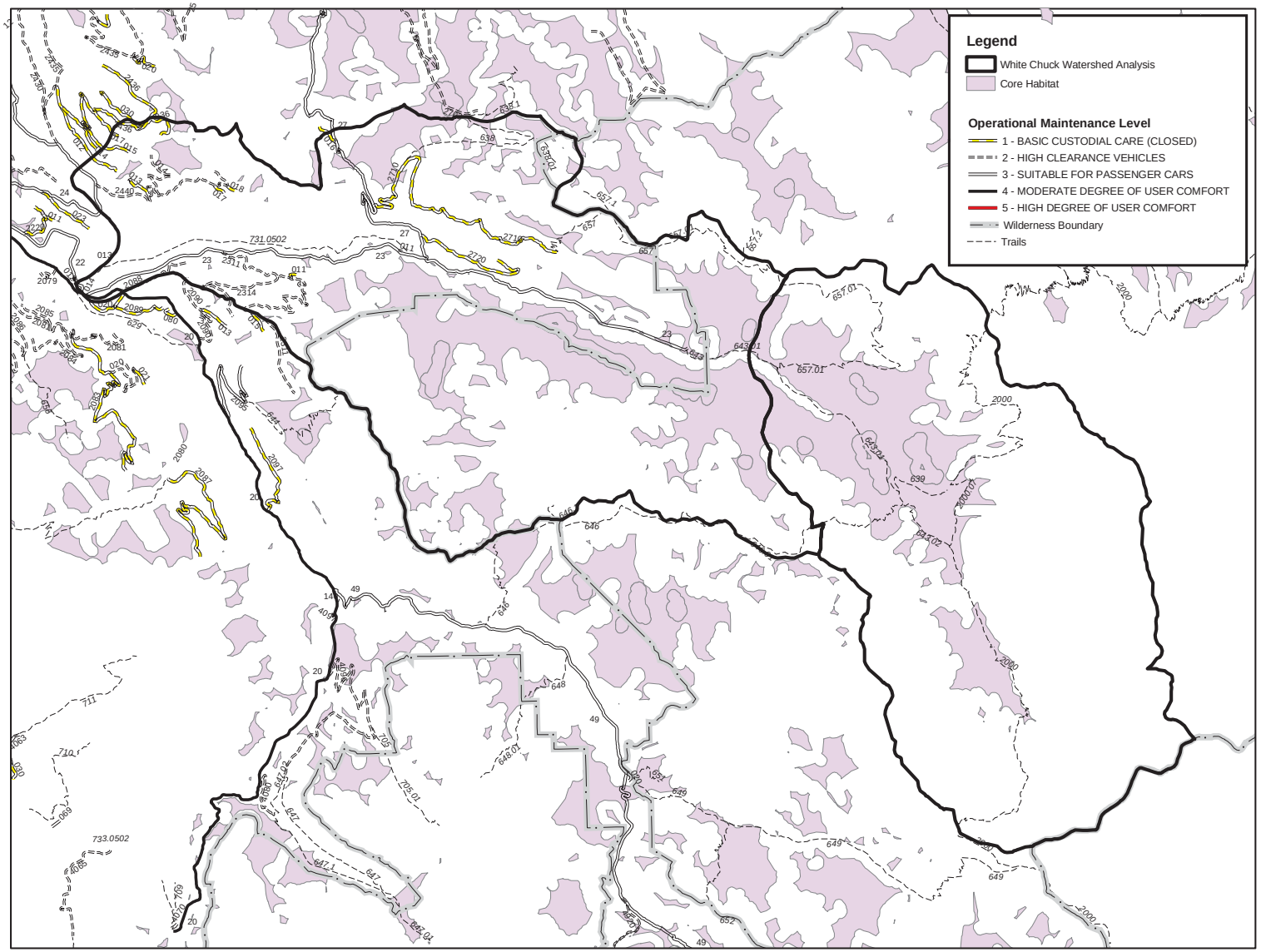
Historically, both the Upper Skagit and Thompson tribes are reported as hunting grizzly bears in the North Cascades and making ceremonial use of the head and meat (Collins 1974). In the book *Two Voices*, members of the Sauk-Suiattle tribe relate stories of hunting the grizzly bear along the Cascade Crest (Blukis Onat, A.R. (editor), Fish, J. Bedal and E. Bedal. 2000). Grizzly bear use of the White Chuck drainage is recorded by former Forest Service employees along the Meadow Mountain trail in the 1940s (Holland, 1980, Ryals, A. 2002/2003), and a grizzly bear sighting is reported to be the origin of the name Greybear camp near Fire Creek Pass (A. Ryals, pers. comm. 2003).

By the early part of the 1940s, the grizzly bear numbers were at low levels within its historic range, and in 1975, the grizzly bear was listed as a threatened species in the lower 48 States. Almack et al. (1993) estimated that in 1991, the number of grizzly bears in the North Cascades was less than 50, and perhaps as low as 5 to 20.

Currently, the North Cascades north of I-90 is designated as a recovery zone for this species. The draft recovery chapter covering the North Cascades emphasizes public education, a need to assess whether re-introduction of bears is needed, a zero grizzly bear mortality goal (Servheen 1997, USDI 1997b), and no net loss of core habitat (USDI 1997b).

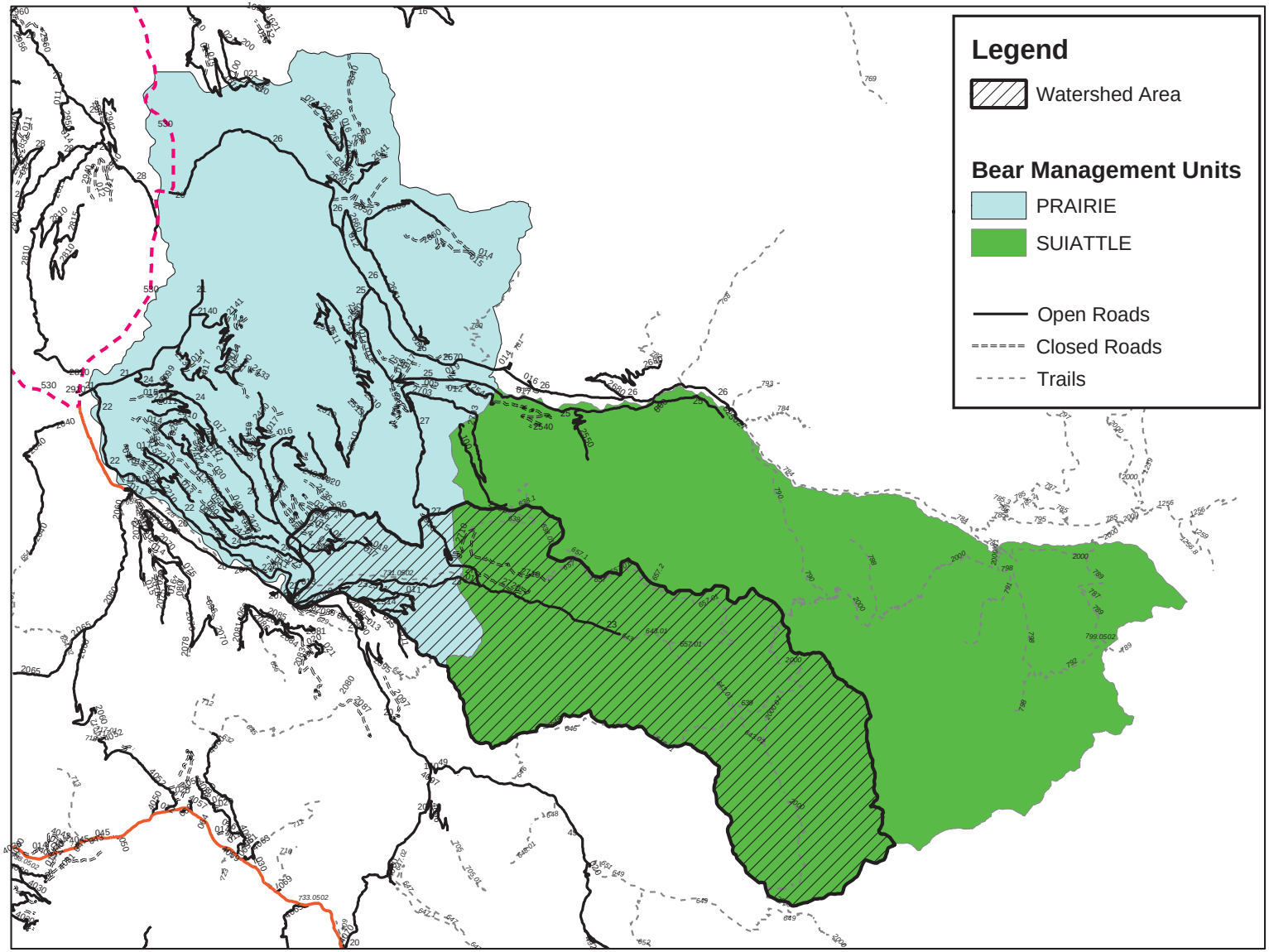
In 1997, the Forest Supervisors of the Wenatchee, Olympic, and Mt. Baker-Snoqualmie National Forests agreed to support an interim recovery standard of "no net loss" in quantity and quality of grizzly bear core habitat. This no net loss policy was for federal lands within any bear management unit (BMU.) The policy is in affect until analyses have been completed and management plans (e.g. Forest Plans) are revised or amended with specific information. Core habitat was designated as the area 0.3 miles from open road systems or 0.3 miles from trails receiving visitor use of 15 parties per week (USDA 1998)

Figure 11 Core Habitat – Area Outside Of Open Road System



Core Habitat -
Area Outside of Buffered Open Road System

Figure 12 Grizzly Bear Management Units



Bear Managment Units

Grizzly bear range over very large areas. Females have established home ranges in excess of 250 square miles. The White Chuck drainage is part of two bear management units (BMU); Prairie Mountain and Suiattle BMUs. The Suiattle BMU has 118,000 acres with approximately 67,500 acres snow-free in the early season (before July 1). Core areas for this BMU are high with 92 percent of the area in security habitat in early season and 75 percent in core habitat in late season (USDA 1998). The Prairie BMU is adjacent to the Darrington area and has 34 percent in core habitat in early season and 32 percent core habitat in late season. This is a small BMU of 90,000 acres of which 64,800 acres are federal lands. Due to the small size of this BMU, the combination of this BMU with adjacent BMUs would provide a better mix of preferred habitat for an average female grizzly bear home range.

There is limited open road or trail access in the Glacier Peak Wilderness portion of the analysis area. In the lower White Chuck portion of the analysis area, there is moderate to high road density (Table 29). Recommendations for grizzly bears in the recovery zones call for maintenance of 5,000 to 15,000 acre security habitat areas well distributed across the landscape. More than 98 percent of core area is in patches of greater than 2,400 acres for both seasons.

Core area connectivity to all adjacent BMUs is better in the spring when there is limited use of trails or roads that are still snow bound. During the late season, habitat connectivity is influenced by high recreational use of roads and trails. Connectivity with core areas are found with adjacent BMUs to the north and east.

Food habitats of grizzly bears in the Cascades are not well known. Historically, grizzly bears in the North Cascades likely made use of anadromous fish, and preyed on carrion from elk, deer, and goats, and hunted insects and small mammals. Vegetation is also a large portion of part of their diet. The high diversity of the vegetation zones of the White Chuck analysis area is thought to include high quality foraging habitat for this species.

Within the basin, spring foraging habitat is found in the lower elevation areas along the main streams and rivers and in avalanche chutes. Spring forage is considered important for rebuilding the bear's nutrition in the post-denning period. Much of the early season habitat is in the riparian areas that are also the locations of many of the roads or trails.

Summer habitat includes a combination of vegetative communities and opportunistic feeding on protein sources. The White Chuck drainage includes 6,580 acres typed as potential forage types in coniferous wetlands, grass/forb communities, open sapling pole stands, shrub lands, shrub wetlands, and wet meadows. There may also be some potential forage areas in the talus slopes, and sparse vegetated areas around the mountain peaks.

Fall foraging habitat includes berry fields, talus slopes, open forests, and areas with seasonal fish runs. The mountain hemlock zone may also provide forage in the huckleberry understory that is associated with much of the mountain hemlock zone; over 13,000 acres (24%) of the analysis area is in the mountain hemlock zone in a plant association group that includes huckleberry species. Both Alaska and big huckleberry are described as forming dense brush fields in the understory of these plant association groups. (Field Guide to the Forested Plant Associations of the Mt. Baker-Snoqualmie National Forest, Henderson et al. 1992).

A potential limiting factor for grizzly bears in the White Chuck analysis area is juggling management of bears and people within the same area. Minimizing potentials for adverse human/bear conflicts is considered a key in the recovery of the grizzly bear, and is a key management consideration in this high recreational use drainage.

Emphasizing proper food management at campgrounds and in the backcountry can eliminate artificial factors, which could attract grizzly bear to these sites. Attractants can include garbage, human food and waste, and livestock feed. High recreational use of unroaded areas or establishment of new trail in trail-less areas is of concern for potential impact to grizzly bear core habitat quality and increased human/bear interactions.

Another limiting factor may be the amount of spring forage areas available, and a lack of abundant seasonal fish runs in the White Chuck drainage. While timber harvesting has increased early seral, open structural habitats in the lower part of the drainage, many of the areas are within three-tenths of a mile of open roads or trails. Many of the roads for timber management have been closed or are in storage so there are limited open roads for additional closure.

Mountain Goat

Mountain goats are a management indicator species for unique habitat on the Mt. Baker-Snoqualmie National Forest. The Forest plan describes management for mountain goats to include: “ Emphasis will be placed on inventory of actual goat use areas, determining goat populations, and investigating causes for the apparent decline in goats numbers (USDA Forest Service 4-44pp. 1990a). Since the 1950s, many local goat populations have declined, resulting in the closure of the Skagit and Stillaguamish River basins to mountain goat hunting in 1995. (WDFW 1995)

In 1990, Forest-wide, the goat population was estimated at 1,300 (USDA Forest service1990b). Currently, available habitat is considered to be in excess of this population, indicating goat populations are below capacity. Over-hunting, parasites and disease, and human disturbance may be primary factors. The Forest Plan has allocated areas to goat habitat prescriptions, with old growth timber adjacent to cliffs identified as important wintering areas. Tree canopy provides cover and forage, and additional forage areas are provided when snow slides from steep areas, exposing moss and underlying vegetation. Lichen on tree boles, and windblown material are considered important winter forage for areas with snow cover over ground vegetation. Areas with cliffs provide security and escape cover from predators.

Population History

Between 1925 and 1948, there were reported to be several localized fluctuations in goat populations attributed to predators and extreme snow conditions (USDA Forest Service 1948). In the 1960s, mountain goats were considered common residents of the alpine areas (USDA Forest Service 1965).

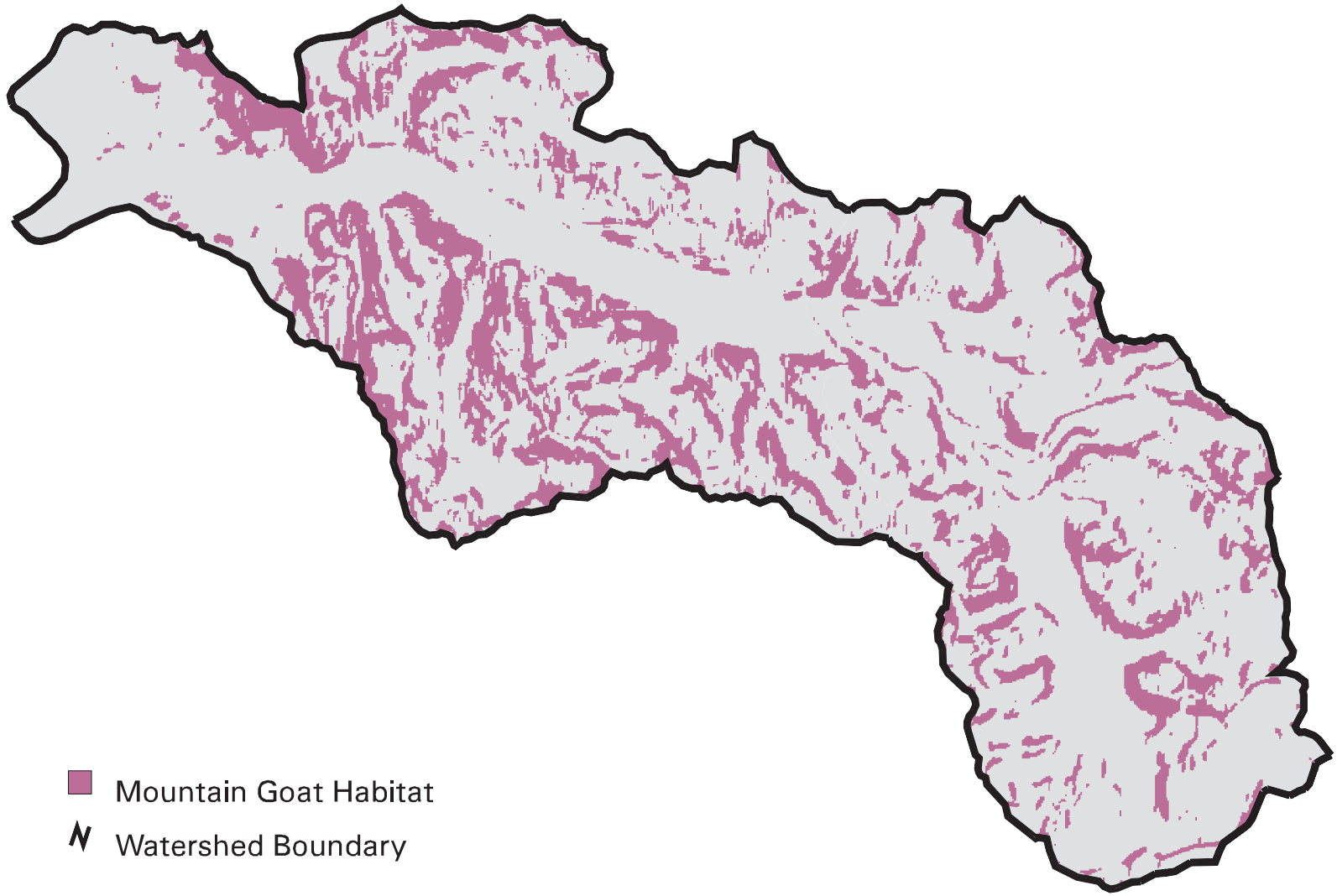
In 1961 and 1962, the Washington Department of Game (WSDG) conducted extensive ground surveys for mountain goats in the North Cascades, with excursions into the White Chuck drainage area. The White Chuck drainage was part of the closed areas for goat hunting at that time and had an estimate of 143 animals. The 1962 survey recorded high counts of 19 animals at Round Lake, 8 at Sunup Lake and 40 goats at Skull Peak and 23 goats on the White Chuck side of Glacier Peak. There were five goats in Chetwot Meadows (upper White Chuck River drainage) and five goats on Pugh Mountain. A helicopter flight in the same year provided a count of seven goats at Round Lake, twenty-nine goats on Skull Peak, three on Black Mountain, and six animals on Pugh Mountain.

In the Darrington District files there is a map dated 1982, with a legend of compiled observations from 1976 through 1980 (USDA Forest Service1982). The map information is attributed to the Washington Department of Fish and Wildlife (WDFW) (including hunter sightings) and general observations. The compilations included summer sightings from White Chuck Mountain, Pugh Mountain, and Glacier Peak Wilderness. This includes numbers of goats noted as 25, 21, 37, 45, 78, 111 and 130 animals on White Chuck Mountain. In the Pugh Mountain area there were reports of 2 to 6 animals, Spring Mountain had reports of 4, 5, 5, and 12 animals and Lost Creek Ridge/Round Mountain had reports of 1, 1, 2, 7, 9, 9 and 12 animals.

In a 1983 published bulletin (WSFW 1983), the overall trend in Washington State was reported as declining goat populations since the 1961 and 1962 department surveys. The 1983 bulletin reported that mountain goat populations in eastern Washington had likely declined 50 percent from the 1961 surveys, and declined 20 percent in western Washington. It was noted that due to ease of hunting accessibility, declines in local areas of western Washington could be greater than the estimated 20 percent.

Local areas of decline included the Falls Creek and Pender's Canyon area of the Darrington District. Additional localized declines on the Darrington District and within the White Chuck drainage are noted in Art Ryals' dairies (notes compiled by Shari Brewer, 2003). Art Ryals is a local resident who has spent a lifetime counting goats in the Darrington area while he hunted, trapped, worked for the Forest Service, and later when retired. Art's dairies provided historic accounts from the 1940s to 1980s of mountain goat numbers on the Darrington Ranger District. The dairies include counts on White Chuck Mountain. Lost Creek Ridge, and Glacier Peak. In 1949, Art and Nels Bruseth made an eight-day trip around Glacier Peak reporting a count of 208 mountain goats. On the White Chuck drainage side, there were 82 animals sighted.

Figure 13 Goat Historic Use Area



Lower in the drainage, on White Chuck Mountain, Art recorded in his dairy reports of over 60 animals on White Chuck Mountain from counts made in 1956 to 1976. By the mid 1980s, his goat counts were down to 40 animals, and by the early 1990s were only 10-20 animals. The most recent goat counts from surveys conducted in 2000-2003 have detected 5 to 7 goats. In the White Chuck Mountain area. The number of young being recruited into the population does not seem to be greater than mortality factors and a decreasing population appears at risk of local extirpation.

Over the years, the State has used a variety of methods for evaluating goat population trends in Washington, information from the goat hunting questionnaires that are sent to all hunters receiving a tag (WSFW 1983), and both ground and aerial surveys. WDFG information from hunters' questionnaires was compiled by Goat Management Units (GMUs). The White Chuck analysis area has been part of several Game Management Units (GMUs) including: Goat Unit 9 (Glacier Peak), Goat Unit 29 (Black), Goat Unit 33 (White Chuck), and Goat Unit 38 (Pugh). While Goat Unit 9 encompasses more than the White Chuck River analysis area, approximately 40 to 50 percent of the Glacier Peak GMU is within the analysis area for the White Chuck River. Goat Unit 33 encompasses both White Chuck and Prairie Mountain and other GMUs are likewise split between drainages. The geographic area encompassed by a GMU changed over the years as some units were divided or other lumped together. These changes in unit boundaries complicate tracking goat populations and hunting pressure over time.

Even with the changes in unit boundaries, the harvest summaries from the WDFG provide estimates of hunter mortality to the goat populations of the area. According to harvest reports for the ten-year period of 1971 to 1981, there were 114 goats reported as harvested by hunters in the Glacier Peak area of Goat Unit 9. The total take of mountain goats is unknown, but the WSDG (1983) estimated an additional 30 percent of the legal harvest could be added to the mortality figures in the form of crippling loss and illegal take per year. This mortality to the population does not include natural mortality from old age, disease, predation, and weather. If goat populations did not have recruitment of young equal or greater than mortality, then the populations would continue to decline. Due to concern with the decreasing goat numbers, in 1992-1993 much of the North Cascades were closed by the State to goat hunting. In 1995, all goat units in Snohomish and Skagit counties were closed to hunting.

Potential Limiting Factors

There are a number of potential limiting factors for mountain goat population growth in the watershed. One potential factor is the past management of goat hunting concurrent with timber harvest, and the likelihood of concentrated hunting pressures related to timber harvest roads providing easy access into higher elevation areas. Increased ease of access by hunters and other recreationists into previously remote areas used by mountain goats may have resulted in localized hunting mortality as well as goat movements away from areas of increased recreational use. Even with the hunting closure of much of the analysis area, the association of people with danger may cause goats to flee areas used by climbers, hikers or backpackers. Many hiking, climbing, and camping sites go into alpine areas such as White Chuck Mountain, Glacier Peak, and Pugh Mountain. Lookout sites and trails are heavily used recreation areas from Pugh Mountain to Lost Creek Ridge Trail, and routes around Glacier Peak.

Past goat hunting allowed up to 50 percent of goats taken to be nannies in the States' goat harvest. Either sex is taken in the hunt due to the difficulty in distinguishing between the billies and nannies. This may have limited recruitment of young into the population, with harvest of goats more additive to goat populations than previously thought. The take of dominant nannies may also affect the use of areas by disrupting goats' social orders. This may have resulted in loss of successful goat migration between summer and winter ranges, and decreased ability to defend against predators (WDFW biologists Pers. Comm. 1994).

Past management of goat habitat may also be a factor. Previously there was the expectation that timber harvest within the winter range could provide additional forage, or early seral vegetation for ruminants. This may have led to road building and timber harvesting into sensitive areas, such as the flanks of Pugh Mountain and White Chuck Mountain. Areas such as the south face of White Chuck and around Pugh Mountain have sustained timber harvest to above 4,000 feet elevation. While the timber harvest created early seral vegetation, roads may have cut across former goat migration routes in the Rat Trap Pass area, and the White Chuck to Prairie Mountain area These roads could have provided additional hunter pressure on the White Chuck and Prairie goat population.

Concern has been expressed by the WDFW that fire suppression may have resulted in meadow areas growing in and providing less forage (R. L. Johnson, 1983). Local concern with the goat populations includes the growing population of cougar that prey on goats and the potential for parasite infestations to limit population rebound in closed game management units (Ryals, Pers. Comm. 1994).

Mountain Goat Research in the Washington Cascade Mountains

Aerial census since 1995 has found limited numbers of mountain goats in the Darrington District even with the hunting closure. Concern from local citizens, the Sauk-Suiattle tribe, other tribes and agencies led to additional ground surveys, and the hiring of a biologist by the Washington Department of Fish and Wildlife (WDFW) in 2001 to specifically work with mountain goat issues in the State of Washington.

In 2002, the WDFW initiated a study in partnership with the Sauk-Suiattle Tribe, Seattle City Light, Western Washington University, the U.S. Forest Service (USFS), the Stillaguamish tribe, the Tulalip Tribe, and the National Park Service (NPS). The study's short-term objectives were to evaluate habitat relations for the mountain goat populations in the Cascade Mountain Range, and to refine survey protocols for mountain goats within the state of Washington. Habitat studies included suitability mapping in the North Cascades based on reported sightings and locations from mountain goats fitted with GPS tracking collars. Studies of collared goats would also provide information on habitat selection, home range, and movements. The study information was expected to assist in the development of a sightability bias model for use in aerial surveys of mountain goats. Long-term objectives are to collect information to assess the magnitude, extent, and causes for the declines in the local mountain goat populations.

In 2002, ground captures of goats were attempted with no success in the North Cascades. In 2003, the MBS biologists completed NEPA for the helicopter capture of mountain goats in both non-wilderness and wilderness areas to fit goats with GPS telemetry collars. Within the White Chuck watershed, there was a goat from the White Chuck Mountain area that was captured and collared (1 out of 7 animals sighted) and a goat in the Round Lake area (1 animal out of 8 sighted). GPS telemetry downloads from these collared animals are beginning to provide information on movements and seasonal habitat selection by these animals.

Additional ground and aerial census are scheduled to further monitor the mountain goat population and to begin collected data on numbers of marked goats observed. The surveys planned for 2004 and 2005 are to collect data to build a more accurate population estimate. The research project is expected to continue for 2-3 years providing information on a management indicator species, especially improving our ability to estimate population changes.

Other Wildlife Species and Habitat

Other wildlife species and habitat use within the White Chuck drainage are not described in this section, and are not discussed in detail in subsequent chapters when they are not pertinent to the discussion of watershed issues and questions in key areas of interest. Such species are described and discussed in Appendix B1

Species listed under the Endangered Species Act (ESA) that may occur in the drainage, but were not identified as major issues in the analysis include: bald eagles, lynx, and gray wolf.

Townsend's big-eared bat, wolverine, and peregrine falcons are at-risk wildlife whose habitat is limited or declining within the watershed. These species are included on the Pacific Northwest Regional Forester's list as a Sensitive Species.

Management Indicator Species (MIS) are species identified in the MBS Forest Plan that are believed to be representative of a larger subset of wildlife species with similar habitat needs. MIS populations or habitat quality are expected to reflect conditions for most other wildlife species on the forest. MIS in the analysis area, but not described in detail include the pine marten, pileated woodpecker, and the black-tailed deer.

Survey and Manage species designated in the Forest Plan are considered concern species due to being restricted in range, rare, or too poorly known. As of 2003, one Survey and Manage Species, a land snail, possibly occurs in the White Chuck watershed (USDI and USDA 2003). There are no documented findings of survey and manage mollusk, but few surveys have been conducted for this snail. This specie is believed to be associated with mature and old growth forests, and is listed as a Survey and Manage species due to its low mobility and lack of habitat connectivity between potential habitats (see old growth forest discussion of marbled murrelet and spotted owl for more information on old growth habitat within the White Chuck drainage).

Other species discussed for habitat concerns include beaver and harlequin ducks in riparian habitat.

Seven species of bats are also of concern from the viability assessment of the Forest Plan, and are associated with snags, and riparian areas. Other Forest Plan species of concern include the fisher and American marten, common merganser. Neotropical birds are of concern from the Birds of Conservation Concern 2002 Act (USDI Fish and Wildlife Service. 2002). The Division of Migratory Bird Management listed species of concern for physiographic regions. The Mount Baker-Snoqualmie National Forest (MBS) is located at the northern end of the Southern Pacific Rainforests physiographic area

Air Quality

A significant portion of the upper reaches of the White Chuck watershed is within the Glacier Peak Wilderness, which is considered a Class I area for air quality protection. The Clean Air Act Amendments of 1977 gives Federal Land Managers, including the Forest Service, "…an affirmative responsibility to protect the air quality related values (including visibility)…within a Class I area."

Visibility is a value that is protected primarily within the boundaries of a Class I area, although the Clean Air Act includes a provision for definition of vistas integral to a visitor's experience even if these vistas extend beyond the boundaries of the Class I area. The Forest Service has never formally defined any "integral vistas" for Glacier Peak or any other Forest Service-managed Class I area in the country. Locally, the Washington State Department of Ecology asks that air-pollution permit applicants include analysis of their effects on views outside Class I area boundaries. Therefore, in working the Department of Ecology, the Mt. Baker-Snoqualmie has identified certain important vistas that originate within Glacier Peak Wilderness and include portions of the White Chuck Watershed including:

- Miners Ridge toward Whitehorse Mountain and Three Fingers,

- Green Mountain towards Whitehorse Mountain and Three Fingers,
- Pacific Crest Trail down White Chuck River towards Whitehorse Mountain and Three Fingers,
- Mt. Pugh summit towards Whitehorse Mountain and Three Fingers,
- Mt. Pugh summit down the Sauk River towards Mt. Baker, and
- Hurricane Peak towards Whitehorse Mountain and Three Fingers.

Smoke from fires can also cause significant visibility impairment. Since wildfires are not generally human-caused, their effects on visibility are considered natural. Smoke from prescribed fire though, is generally considered to cause unnatural visibility impairment except in the case where prescribed fire is used for ecosystem management purposes within an ecosystem that is largely in a natural condition.

Glacier Peak Wilderness visibility is officially monitored at an IMPROVE (Interagency Monitoring of Protected Visual Environments) site shared with the National Park Service and located at Ross Lake. Another IMPROVE site is located at Snoqualmie Pass for Alpine Lakes Wilderness and has some applicability to conditions at Glacier Peak. Visibility at Glacier Peak Wilderness probably falls somewhere in between what is measured at the two sites.

Figure 14 Standard Visual Range At Two Sites shows average seasonal and annual standard visual range in miles as measured in 2001 (the most recent year with complete data). Standard visual range is simply how far someone can expect to see through the atmosphere. Theoretical maximum visual range with nothing in the air except natural components of the atmosphere is about 240-miles but even without the influence of human-caused air pollution, visibility would not always reach this limit. Naturally occurring particles of dust, smoke, pollen, and gaseous hydrocarbons contribute to visibility impairment. Average natural visibility in the western US is estimated to be about 110-115 miles. The annual average standard visual range measured at Ross Lake is very close to this showing that generally, visibility is excellent at this location. Visibility at Snoqualmie Pass is rather more impaired. The general sources of visibility impairment at both sites are shown in Figure 15 Sources Of Visibility Impairment.

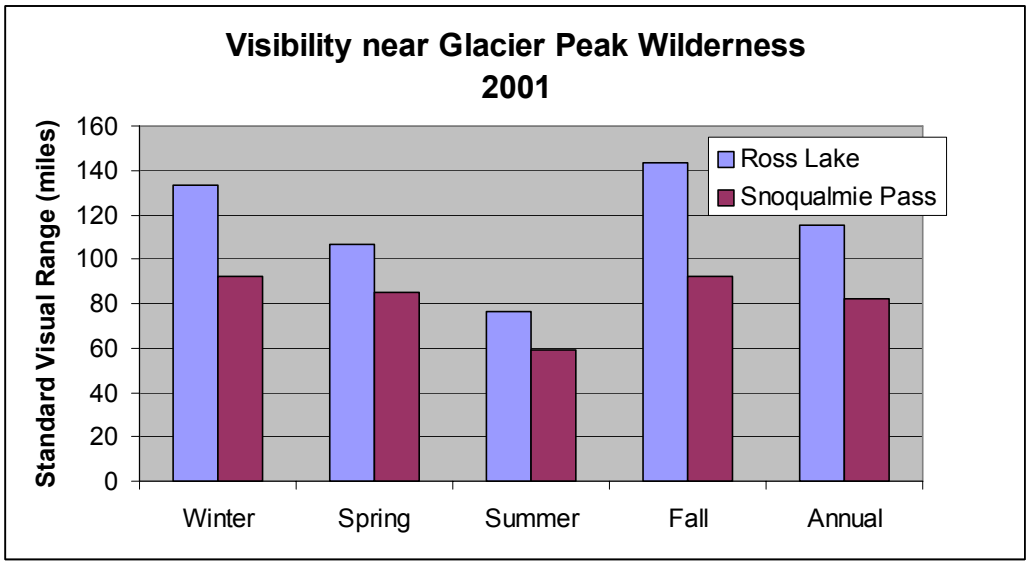


Figure 14 Standard Visual Range At Two Sites

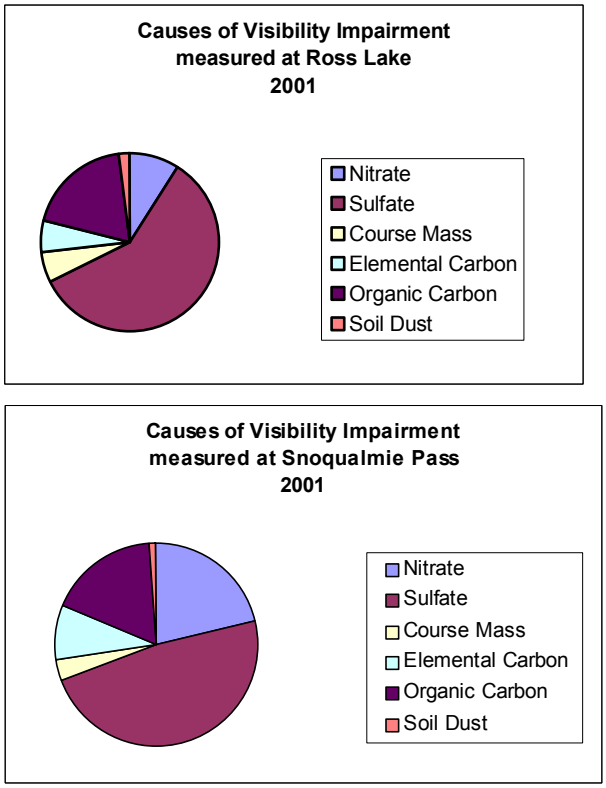


Figure 15 Sources Of Visibility Impairment

Identifying exactly what and who is causing visibility impairment can be challenging. Common sources of the pollutants measured by the IMPROVE monitors include:

- Nitrates: Automobiles, any combustion source.
- Sulfates: Coal/Oil fired power plants, refining and smelting.
- Course Mass: Smoke, pollen.
- Elemental Carbon: Diesel, oil, and coal combustion.
- Organic Carbon: Biogenics, industrial solvents, smoke.
- Soil Dust: Unpaved roads, agriculture.

In addition to visibility, other Air-Quality-Related-Values (AQRV's) of particular interest in the White Chuck watershed include surface waters, and flora. Surface waters can become acidified through atmospheric deposition of pollutants; and sensitive flora (lichens especially) can be injured or killed from pollutant deposition or airborne concentrations of pollutants such as ozone.

Ozone monitoring was conducted near the White Chuck Watershed on the Sauk Prairie from 1994-1996 and revealed relatively low concentrations that should not be of concern. Higher elevations within the watershed could easily be experiencing higher concentrations of ozone but due to monitoring equipment requirement for electrical power, further monitoring is probably not possible.

The Forest has been sampling lakes for chemistry and looking signs of acid deposition but no lakes within the White Chuck watershed have yet been sampled. Lakes in Alpine Lakes Wilderness have in general, been found to be far more sensitive than lakes in Glacier Peak Wilderness due to geology and soils.

Air Quality Trends

Visibility monitoring should continue at Ross Lake and Snoqualmie Pass to track this important and sensitive AQRV, and to identify sources of visibility impairing pollutants near Glacier Peak Wilderness. The Forest should continue to work proactively with the Washington Department of Ecology to protect visibility in and near Glacier Peak Wilderness through their pollution permit program. Lakes within the watershed should be sampled for chemistry although the White Chuck watershed is probably a lower priority than other areas of the Forest.

Fire planning should include analysis of potential visibility impacts, especially in the case of utilization of fire for something other than ecosystem management in natural stands. Smoke from fires can cause significant human health impacts and any plans to use prescribed fire or allow for natural fires should include analysis of smoke impacts in local communities.

Human Use

Timber Harvesting

Around 1901, the Northern Pacific Railroad Company built a railroad from the North Fork Stillaguamish River to Darrington. Equipment for the first sawmill was delivered by way of this railroad, and the Darrington Lumber Company was established in the town of Darrington.

The Sauk River Lumber Company was started early in 1922. By late 1922, the company had completed a ten mile-long railroad line within the Sauk River drainage. The company purchased National Forest and other timber, transporting it to Darrington on the railroad line. From Darrington the logs were then transported on the Northern Pacific line to Everett. The Sauk River Lumber Company operated the largest portable logging camp in the Puget Sound area. The entire camp was built on railroad flat cars and could be moved any place the railroad could go. In 1923, the camp was moved to a location just east of the confluence of the Sauk and the White Chuck Rivers. The camp remained for a couple of years, and then moved on to another location. In 1943, the camp returned to the location near the Sauk and White Chuck Rivers. It remained in this site for about ten years, and then was moved back to Darrington.

Timber harvesting in the watershed started slowly in the late 1920s with increasing activities through the 1930s, 1940's, and into the 1950s. Throughout the 1940s, railroads were used to transport the logs from the woods to the mills. About the mid 1940s, the transportation method evolved from trains and rails to trucks and roads. However, trains were still being used to haul the logs between Darrington and Everett. Operations during this time-period changed little. Trees were felled with axes and crosscut saws, (use of chainsaws started in the early 1950s). Logs were yarded by high-lead cable systems powered by portable donkey engines on the steeper slopes and tractors on the lesser slopes. Truck hauling became the preferred method of transporting logs. Road building and truck hauling offered an increased opportunity to access more harvestable timber in the watershed than with railroads.

From the1930s through the 1950s, the areas being logged were large and contiguous. Since the 1950s, the harvest unit size has decreased, and they have become dispersed throughout portions of the watershed. From the late 1920s to the late 1990s, the predominant method of harvesting, or stand management, was clear-cutting. The following table shows the approximate acres of clear cutting by decade that has occurred in the past within this watershed.

Table 27 Clear Cut Acres By Decade

Decade	1920	1930	1940	1950	1960	1970	1980	1990	Total Acres
Acres Cut	50	1,090	990	860	910	90	860	90	4,940

The 4,940 acres harvested in the past eight decades represents only 9.1 percent of the entire acreage of the watershed. It also represents 31.6 percent of the non-wilderness acreage within the watershed (Seventy-one percent of the watershed is designated wilderness where timber harvest is not allowed).

Currently the vegetation in the non-wilderness portion of the watershed is made up of about 19 percent seedlings and saplings; 58 percent small poles to medium sized saw timber; and 23 percent is considered larger saw timber.

The last active timber sale that was harvested through clear cutting was in 1994. From 1994 to today, there have been no new timber sales in this watershed. In recent years, the major focus in timber management has been concentrated on the younger stands of timber. Commercial thinning is the current predominant method of timber harvest management on the Mt. Baker-Snoqualmie National Forest.

Special Forest Products

Special Forest Products, (sometimes called “other forest products”), are categorized as convertible and non-convertible products. Those natural resources which are converted from logs to a smaller useable specialized form, such as fence posts, poles, cedar shakes, and firewood, etc. are considered convertible products. Natural resources such as mushrooms, berries, seedling transplants, floral greens, Christmas trees, and tree boughs are considered non-convertible products.

Mt. Baker-Snoqualmie National Forest policy is generally to sell Special Forest Products Permits to the public for their personal use only. There are three exceptions to this personal-use only policy: Commercial permits are sold to gather and purchase seed cones for tree growing companies, for cutting tree bough for holiday decorations, or for digging conifer and hardwood seedling transplants.

The White Chuck watershed includes a variety of special forest products collections; the most common permits are for firewood and transplants. The watershed is not well roaded for access to other products. Wilderness areas are excluded from all harvesting of special forest products. There is no inventory recording the availability, history, and trends to define product sustainability and harvesting potentials.

The Special Forest Products program has changed little in the past few years. Because of limited funding, there is little opportunity for expansion or improvement. As the public becomes more aware of the potentially available forest products, their demand increases. This trend is expected to remain constant or increase in the future. Illegal harvesting of special forest products is an ongoing concern throughout the accessible portions of the watershed. Illegal harvesting is expected to continue or increase as the value of certain special forest products increases. Cedar for shakes and shingles are a good example of a commodity that is prone to illegal removal.

Road Infrastructure

All of the roads on the National Forest lands were constructed initially for timber harvest activities, with roads along the valley floor being constructed first, in many cases along existing or abandoned railroad lines as early as the 1940s and 1950s. By the mid 1960s, the roads for timber harvest were being built in the steeper terrain of the watershed. Although built originally for timber access, inmost cases a large portion of the road system has evolved to serve multiple forest management access objectives. Included in these objectives are public access for dispersed camping, hunting, fishing, mountain climbing, wildlife and scenic viewing, berry picking, and trailhead access to both wilderness and non-wilderness areas, to name a few.

Due to early road construction practices before 1970, as well as the age of many of the existing drainage structures, a significant portion of the system requires either upgrading on roads where access needs to be maintained; or, decommissioning treatment. These upgrades or treatments were performed to prevent unacceptable environmental damage (fish migration blockages, sedimentation, erosion, etc.) at locations where the decision is made to move road segments from the transportation system.

Within the analysis area, there are approximately 55.29 miles of existing roads. Table 28 gives a breakdown of these road miles by ownership.

Table 28 Road Miles by Ownership

National Forest System Roads	43.9 miles
National Forest Non-System Routes	0.00 miles
State, County, and Private Roads	0.2 miles
Total Miles	44.1 miles

The total miles of the listed roads are currently distributed into the following (below) maintenance levels in INFRA Travel Routes database:

Table 29 Road Miles by Maintenance Levels

Road Maintenance Level	Operational Level Miles	Objective Level Mile
Decommission		4.3
Level 1 (Closed – In Storage)	15.2	13.7
Level 2 (Open – Maintained. For High Clearance Vehicles)	12.8	8.2
Level 3-5 (Open – Maintained. For Passenger Cars)	16.1	17.8

Roads Analysis

The Forest completed a forest-wide roads analysis in 2002 as per direction in Forest Service Manual (FSM) 7712.15 and Interim Directive 7710-2001-1 dated May 31, 2001. That analysis rated all roads for access need and resource concerns. Table 31 Roads Analysis Results for White Chuck Watershed shows the results for roads, entirely or partially, within the White Chuck River. The majority of the roads are considered as needed for access. Access needs are predominantly to maintain management options for matrix lands (Northwest Forest Plan land allocation) and secondarily for recreation (access to trailheads or campsites and driving for pleasure). Resource concerns generally rated high for potential or existing effects on aquatic and wildlife resources. This combination of high need and high concern places all but a few of the roads in the management category for high priority to maintain and/or stabilize. Emphasis would be placed on retaining access while minimizing effects on other resources. Retaining access could mean that a road is closed and in storage when not needed for project work.

Several roads have been decommissioned in the subwatershed (Table 30 Decommissioned Roads). These are generally short spur roads off the main White Chuck Road 23 and Road 2710 on the north side of the river.

Table 30 Decommissioned Roads

Decommissioned Roads	
Route No.	**General Location**
N230002	*Lower White Chuck*
N230003	*Lower White Chuck*
N230004	*Lower White Chuck*
N231101	*Pugh Ridge*
N271001	*Meadow Mountain*
N271002	*Meadow Mountain*
N271011	*Crystal Creek*

The Roads Analysis information is retained in Oracle (INFRA) and Access databases. This roads analysis relational database facilitates nesting different levels of the analysis and linking to other databases. The database allows easy queries and access to all pieces of information. A wide range of information was synthesized to result in broad management scenarios, however all the information is retained within the database.

The following corrections need to be made in the Roads Analysis Database and the Access and Travel Management Plan:

- Road 2088 has a High need for access for Matrix, so the objective level should be Level 1 instead of Decommission;
- Road 2090 has a High need for access for Matrix;
- Road 2200013 has a High need for access for Matrix and Recreation (trailhead at 0.3 miles);
- Road 2436036 should have an objective Level 1 and not Decommission since it has a High need for access for Matrix; and
- Road 27 has a High need for access for Matrix.

Table 31 Roads Analysis Results for White Chuck Watershed

Road segments are derived from the INFRA database.

Road Number	Name/Location	Beginning MP	Ending MP	Objective Level	Operation. Level	Access Needs				Resource Concerns			Mgmt Rating	General Management Approach
						LSR	Matrix	Cultural	Recreation	Aquatic	Wildlife	Cultural		
2088000	White Chuck Bench	0	0.9	D	2	L	L	L	L	L	M	L	L/L	Close/ decommission
2090000	West Pugh	1.2	1.3	2	2	L	L	L	L	L	M	L	L/L	Close/ decommission
2200000	*White Chuck bridge*	10.7	10.9											Not rated
2200013	White Chuck Pit	0.3	0.4	1	2	L	L	L	L	L	L	L	L/L	Close/ decommission
2200014	*White Chuck CG*	0	0.6											0.5 washed away 1995
2300000	White Chuck	0	10.3	3	3	L	H	L	H	H	M	L	H/H	Maintain/stabilize
2300011	Crystal Cr Camp	0	0.1	2	2	L	L	L	H	H	L	L	H/H	Maintain/stabilize
2300016	Owl Creek Camp	0	0.2	2	2	L	L	L	H	H	L	L	H/H	Maintain/stabilize
2311000	Pugh Ridge	0	5.4	2	2	L	H	L	L	H	M	L	H/H	Maintain/stabilize
2311011	Pit Access Road	0	0.3	1	1	L	H	L	L	M	H	L	H/H	Maintain/stabilize
2314000	Backside Pugh	0	2.1	2	2	L	H	L	L	H	M	L	H/H	Maintain/stabilize
2436000	Upper Black Oak	0	5.3	2	1	L	H	L	L	H	H	L	H/H	Maintain/stabilize
2436012		1.0	1.5	1	1	H	H	L	L	L	H	L	H/H	Maintain/stabilize

2436015			1.0	1	1	L	H	L	L	L	H	L	H/H	Maintain/stabilize
2436030		0.1	2.4	1	1	L	H	L	L	L	H	L	H/H	Maintain/stabilize
2436036		0	0.62	D	1	L	H	L	L	H	H	L	H/H	Maintain/stabilize
2440000	Black Oak	0	3.1	1	2	L	H	L	L	H	H	H	H/H	Maintain/stabilize
2440013		0	0.4	1	1	L	H	L	L	M	H	L	H/H	Maintain/stabilize
2440014	Mid Black Oak	0	1.36	1	2	L	H	L	L	H	H	L	H/H	Maintain/stabilize
2440017		0	0.3	1	1	L	H	L	L	M	H	L	H/H	Maintain/stabilize
2440018		0	0.16	1	1	L	H	L	L	M	H	L	H/H	Maintain/stabilize
2700000	Straight Creek	0	3.9	3	3	L	L	L	H	H	H	L	H/H	Maintain/stabilize
2710000	Meadow Mountain	0	1.5	3	1	L	H	L	M	L	M	L	H/M	Maintain/stabilize
2710000	Meadow Mountain	1.5	6.5	1	1	L	H	L	L	H	M	L	H/H	Maintain/stabilize
2720000	Meadow Sky	0	2.5	D	1	L	H	L	L	M	M	L	H/M	Maintain/stabilize

Table 32 Roads Within White Chuck WA by Operational Level

Road No.	Begin Mile	End Mile	Jurisdiction	Functional Class	Operational Maintenance Level	Miles In Watershed
2200014	0.1	0.6			D - Destroyed By 1995 Flood	0.5
2311011	0	0.3	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.3
2436000	0.466	0.497	FS - Forest Service	C - Collector	1 - Basic Custodial Care (Closed)	0.030997
2436000	4.047	4.723	FS - Forest Service	C - Collector	1 - Basic Custodial Care (Closed)	0.676332
2436012	1.01	1.5	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.490246
2436013	0	0.3	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.3
2436014	0	0.46	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.46
2436015	0	1	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	1
2436017	0.101	0.13	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.02878
2436030	0	0.121	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.120539
2436030	0.179	0.243	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.063864
2436035	0	0.52	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.52
2436036	0	0.62	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.62
2440013	0	0.4	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.4
2440017	0	0.3	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.3
2440018	0	0.16	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.16
2700016	0	0.229	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	0.229347
2710000	0	1.5	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	1.5
2710000	1.5	6.5	FS - Forest Service	L - Local	1 - Basic Custodial Care (Closed)	5
2720000	0	2.5	FS - Forest Service	C - Collector	1 - Basic Custodial Care (Closed)	2.5
2088000	0	0.046	FS - Forest Service	L - Local	2 - High Clearance VehicleS	0.045588
Level 1 Total15.2						
2088000	0.454	0.9	FS - Forest Service	L - Local	2 - High Clearance VehicleS	0.44589
2090000	1.263	1.3	FS - Forest Service	C - Collector	2 - High Clearance VehicleS	0.036892

Road No.	Begin Mile	End Mile	Jurisdiction	Functional Class	Operational Maintenance Level	Miles In Watershed
2200013	0.234	0.3	FS - Forest Service	L - Local	2 - High Clearance VehicleS	0.065633
2200013	0.3	0.421	FS - Forest Service	L - Local	2 - High Clearance VehicleS	0.120754
2200014	0	0.1	FS - Forest Service	L - Local	2 - High Clearance VehicleS	0.1
2300011	0	0.1	FS - Forest Service	L - Local	2 - High Clearance VehicleS	0.1
2300016	0	0.2	FS - Forest Service	L - Local	2 - High Clearance VehicleS	0.2
2311000	0	5.4	FS - Forest Service	C - Collector	2 - High Clearance VehicleS	5.4
2314000	0	1.783	FS - Forest Service	C - Collector	2 - High Clearance VehicleS	1.783312
2440000	0	3.1	FS - Forest Service	C - Collector	2 - High Clearance VehicleS	3.1
2440014	0	1.36	FS - Forest Service	L - Local	2 - High Clearance VehicleS	1.36
			Level 2 Total	12.8		
2200000	10.669	10.873	FS - Forest Service	A - Aterial	3 - Suitable for Passenger Cars	0.203708
2300000	0	10.483	FS - Forest Service	A - Aterial	3 - Suitable for Passenger Cars	10.483
2400000	8.763	9.145	FS - Forest Service	A - Aterial	3 - Suitable for Passenger Cars	0.381351
2400000	10.663	11.104	FS - Forest Service	A - Aterial	3 - Suitable for Passenger Cars	0.440647
2700000	0	3.908	FS - Forest Service	C - Collector	3 - Suitable for Passenger Cars	3.90804
2000000	6.4	6.89	FS - Forest Service	A - Aterial	4 - Moderate Degree of User Comfort	0.489618
2000000	6.198	6.4	C - COUNTY	A - Aterial	5 - High Degree of User Comfort	0.201565
			Level 3-5 Total	16.1		
			Total Miles in Watershed	**44.1**		

Table 33 Roads Within White Chuck WA by Objective Level

Road No.	Begin Mile	End Mile	Jurisdiction	Functional Class	Operational Maintenance Level	Miles in Watershed
2200013	0.3	0.421	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.120754
2311011	0	0.3	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.3
2436012	1.01	1.5	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.490246
2436013	0	0.3				0.3
2436014	0	0.46	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.46
2436015	0	1	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	1
2436017	0.101	0.13	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.02878
2436030	0	0.121	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.120539
2436030	0.179	0.243	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.063864
2436035	0	0.52	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.52
2440000	0	3.1	FS - Forest Servce	C - Collector	1 - Basic Custodial Care (Closed)	3.1
2440013	0	0.4	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.4
2440014	0	1.36	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	1.36
2440017	0	0.3	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.3
2440018	0	0.16	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	0.16
2710000	1.5	6.5	FS - Forest Servce	L - Local	1 - Basic Custodial Care (Closed)	5
			Level 1 Total	13.7		
2090000	1.263	1.3	FS - Forest Servce	C - Collector	2 - High Clearance VehicleS	0.036892
2300011	0	0.1	FS - Forest Servce	L - Local	2 - High Clearance VehicleS	0.1
2300016	0	0.2	FS - Forest Servce	L - Local	2 - High Clearance VehicleS	0.2
2311000	0	5.4	FS - Forest Servce	C - Collector	2 - High Clearance VehicleS	5.4
2314000	0	1.783	FS - Forest Servce	C - Collector	2 - High Clearance VehicleS	1.783312
2436000	0.466	0.497	FS - Forest Servce	C - Collector	2 - High Clearance VehicleS	0.030997
2436000	4.047	4.723	FS - Forest Servce	C - Collector	2 - High Clearance VehicleS	0.676332

Road No.	Begin Mile	End Mile	Jurisdiction	Functional Class	Operational Maintenance Level	Miles in Watershed
			Level 2 Total	8.2		
2200000	10.669	10.873	FS - Forest Servce	A - Aterial	3 - Suitable for Passenger Cars	0.203708
2200013	0.234	0.3	FS - Forest Servce	L - Local	3 - Suitable for Passenger Cars	0.065633
2200014	0	0.1	FS - Forest Servce	L - Local	3 - Suitable for Passenger Cars	0.1
2300000	0	10.483	FS - Forest Servce	A - Aterial	3 - Suitable for Passenger Cars	10.483
2400000	8.763	9.145	FS - Forest Servce	A - Aterial	3 - Suitable for Passenger Cars	0.381351
2400000	10.663	11.104	FS - Forest Servce	A - Aterial	3 - Suitable for Passenger Cars	0.440647
2700000	0	3.908	FS - Forest Servce	C - Collector	3 - Suitable for Passenger Cars	3.90804
2710000	0	1.5	FS - Forest Servce	L - Local	3 - Suitable for Passenger Cars	1.5
2000000	6.4	6.89	FS - Forest Servce	A - Aterial	4 - Moderate Degree of User Comfort	0.489618
2000000	6.198	6.4	C - COUNTY	A - Aterial	5 - High Degree of User Comfort	0.201565
			Level 3-5 Total	17.8		
2088000	0	0.046	FS - Forest Servce	L - Local	D - Decommissioned	0.045588
2088000	0.454	0.9	FS - Forest Servce	L - Local	D - Decommissioned	0.44589
2436036	0	0.62	FS - Forest Servce	L - Local	D - Decommissioned	0.62
2700016	0	0.229	FS - Forest Servce	L - Local	D - Decommissioned	0.229347
2720000	0	2.5	FS - Forest Servce	C - Collector	D - Decommissioned	2.5
2200014	0.1	0.6			D - Decommissioned 1995 Flood	0.5
			Decommission Total	**4.3**		
			Total Miles in Watershed	**44.1**		

Communities and Settlements

National Forest land is an important supply of many natural resources for the surrounding area, including timber, water, recreation, mineral, fisheries, and wildlife. The Puget Sound region is one of the fastest growing areas in the United States. The population, though far from uniform, tends to be young and well educated, with incomes above the national average. The economy is highly diversified.

Recreation visitors spend money to acquire equipment related to their recreation activities and they spend money on food, transportation, lodging and other services for travel to and from their recreation sites. Much of this money is spent near their home area, or area of origin, before the start of the trip. Some of the money will be spent along the way and possibly near the destination site. These expenditures contribute to personal income, and to the creation and maintenance of jobs in the affected economic sectors (e.g., lodging, gas and oil, groceries, restaurants, auto repair, etc.).

Darrington is a small rural community that has been impacted by the changes in the timber industry during the past two decades. The local economy was dependent on the timber industry, but the community is trying to also include tourism, value added wood products, small businesses, and light industry.

Records from the 2000 Census data for the Darrington area (town plus rural areas to the east and north) had a population of 2,821 people, in 1,131 households. The Sauk-Suiattle Tribe Reservation is located seven miles northeast of Darrington and has a population of about seventy.

Within the city limits, the 2000 Census reports 1,136 people occupying 473 households, as compared to 1990 Census, where the population was reported as 1,042 in 421 households General Population and Housing Characteristics: 1990 (Source: U.S. Bureau of the Census, 1990 Census of Population and Housing Summary Tape File 1 (100% Data))

In 1990, 400 (60%) people worked in the area and 280 (40%) commuted from 15 minutes to 2 hours to work outside the area. According to the 2000 Census Report, 440 (34%) people (ages 16 and older) commute less than 15 minutes to work, and 795 (66%) people commute anywhere from 15 minutes to 90 minutes.

In 1990, Summit Timber Company was the main employer with about 370 employees during its peak production periods, and down to 240 more recently. In 2002, Summit sold the lumber mill to Hampton Lumber Mill. Currently there are 160 people employed by the Hampton Mill Company. The Darrington School District is the second largest employer at about 78 employees, followed by Oso Lumber Company - Truss Division at 70 employees.

In 1990, the median household income was $21,574 and over sixty-two percent of the families were considered in the low-income level.

Agriculture, Forestry, Fishing & Hunting	--	6
Construction	6	11
Manufacturing	45	23
Warehouse, Transportation, Utilities	4	4
Information	--	1
Realty, Insurance Finance	--	4
Waste Management	--	2
Professional Scientific, Administrative	--	3
Wholesale	5	3
Retail	15	9
Educational, Health, Social Services	--	20
Healthcare, Social Assistance	--	7
Arts, Entertainment, Food Service	--	4
Public Administration	3	3

Table 34 Employment Types Categories, Comparison

The 2000 Census Report shows that the 1999 median household income was $32,813 and of the 607 students in the Darrington School District 51 percent qualify free or reduced lunch programs for low-income families (Myra Lewis, Darrington School District, Pers. Comm. 2003).

Recreation

Wilderness

The Glacier Peak Wilderness is a Congressionally Designated Reserve Area. Wilderness comprises 71percent of the watershed. The goal of wilderness management as stated in the Forest Plan is to "feature naturalness, provide opportunities for solitude, challenge and inspiration and within these constraints to allow for recreational, scenic, scientific, educational, conservation and historical uses." It further states, "The criteria used for conflict will be to preserve and protect the wilderness resource." The trail is within Transition/Trailed Zone of the Wilderness Recreation Opportunity Spectrum (WROS). Current use of the White Chuck Trail and adjacent areas is considered to be within the Limits of Acceptable Change (LAC) for WROS Transition Zone.

The White Chuck Trail provides access into the Glacier Peak Wilderness for a multitude of users including climbers on Glacier Peak, day and overnight campers at Kennedy Hot Springs Camp and hikers and equestrians on the Pacific Crest Trail. Use season is generally from mid-May to October. The majority of visitors are from the Puget Sound area with a smaller number from other states or nearby communities. The following table displays the numbers of users and days by destination for 2000. This information comes from the trailhead registration sheets, and then adjusted for an 83 percent compliance rate as determined by automatic trail counters during the 2000 season.

Table 35 White Chuck Trail User Numbers and Days for Year 2000

Destination	Number of Users	Average Trip Length	Total Use Days	% Of Use Days
Glacier Climbers	850	3.2	2720	45%
Kennedy Hot Spring Area	950	1.6	1615	27%
Pacific Crest Trail	245	4.7	1155	19%
Meadow Mountain	45	2.5	110	2%
Lake Byrne	160	2.5	400	6%
Camp Lake	20	3.0	60	1%
Total Trail Use	**2270**	**2.7**	**6060**	**100%**

Use begins in the spring and steadily increases as upper elevations begin to melt out. Primary recreational use is visitors to the Kennedy Hot Spring Camp area, hikers on the Pacific Crest National Scenic Trail and climbers on Glacier Peak. The October 2003 flood destroyed the Kennedy Hot Springs cabin and buried the Hot Springs and the surrounding area in the thick layer of mud and debris. Use will shift away from the Hot Springs area due to the damage at this destination and the severe damage to the White Chuck Trail.

Through travelers on the PCT as well as backpackers on Lost Creek Ridge and Meadow Mountain trails, utilize a number of established campsites and Wallowa toilets. Group size within the Glacier Peak Wilderness is limited to *12 "heartbeats"*—which includes stock animals. With the exception of Lake Byrne, campfires are allowed in the White Chuck drainage. Building, maintaining, attending or using a fire or campfire, except self-contained, carry-in devices such as stoves, is prohibited within one-fourth-mile slope distance of Lake Burns. (*Special Order #05-20-88-004, 36 CFR 261.52 (a))* This special order was in response to the increased amount of fire scarring, trash accumulation and damage to living trees for firewood purposes within the lake basin. Revegetation of some areas in the Lake Byrne area occurred in the late 1980s and early1990s to arrest the spread of denuded, hardened sites and social trails. In the early 1990s, five cables for backpackers to hang food and trash were installed at some campsites at Kennedy Hot Springs in response to recent bear encounters. The following table displays the number of campsites and toilets by trail and area.

Table 36 Wilderness Campsites and Toilets

WHITE CHUCK TRAIL		
Campsite Name	**# Campsites**	**# Toilets**
Owl Creek	7	2
Pumic Creek	3	
Sand Bar "The Beach"	3	
Glacier Creek	2	
Kennedy Hot Springs	20	4
LOST CREEK RIDGE TRAIL		
Campsite Name	**# Campsites**	**# Toilets**
Byrne Basin	1	
Lake Byrne	6	1
Camp Lake	6	
Hard Tack Lake	3	
Round Lake	13	1
PCT NORTH FROM KENNEDY HOT SPRINGS		
Campsite Name	**# Campsites**	**# Toilets**
Glacier Creek/Kennedy Ridge	7	1
Pumice Creek	5	
Grey Bear	3	

PCT SOUTH FROM JCT OF KENNEDY RIDGE TRAILTO RED PASS		
Campsite Name	**# Campsites**	**# Toilets**
Kennedy Creek	2	
Upper Sitkum Camp	4	1
Lower Sitkim Camp	1	
Baekos Creek	4	
Chetwot Meadow	1	
Callus Palms	6	
Upper White Chuck Bridge	1	
Glacier Peak Meadows	15	1
OFF TRAIL		
Campsite Name	**# Campsites**	**# Toilets**
Boulder Basin	25	1
Disappointment Peak	3	
MEADOW MOUNTAIN TRAIL		
Campsite Name	**# Campsites**	**# Toilets**
Fire Creek (south of)	2	

Trails

Many of the trails in the White Chuck watershed were built in the early 1920s. Fire crews first built the trails primarily for access to the backcountry. The building of the trails allowed for stock access and the ability to transport materials and tools needed to construct lookouts and guard stations. The Kennedy Guard Station at Kennedy Hot Springs was built in 1924 and first served as a fire cache until 1964 when fireguards became wilderness rangers. Forest Service recreation maps from 1933 indicate the Meadow Mountain Trail was the main tie between the Suiattle and White Chuck drainages for access to guard stations, work camps and lookouts.

Timber sales and road construction from the mid 1970s through 1980s included obliteration of a large portion of the Meadow Mountain Trail and the Crystal Lake Trail. This activity also severed the trail connection between the White Chuck drainage and the Suiattle River drainage. The expansive road system, however, allowed for easier and some shorter access to alpine lakes and meadows and increased hiker, climber, and stock use.

The White Chuck drainage contains 15.4 miles of the Pacific Crest Trail National Scenic Trail (PCT). The trail was designated in 1968 as a National Scenic Trail and was one of the initial elements of the enactment of the "National Trails System Act" of 1968. The PCT tied together the Skyline Trail in Oregon. The Cascade Crest Trail in Washington and a route that traveled the crest of the Sierra Nevada Mountains. Development and construction of the Cascade Crest was begun in 1935. The current PCT location through the Darrington District was completed by the early 1970s. Portions of the 14.5 miles of PCT from Red Pass to Fire Creek appear to be original Cascade Crest Trail constructed during the 1930s. The current location of the White Chuck Trail was built in the mid 1960s. Earlier locations were on the east side of the river or on a bench above the current location.

Current Trail System

In October 2003, a devastating flood washed away large portions of the White Chuck Trail, White Chuck Bench Trail, Pacific Crest Trail, and numerous bridges. Damage on the White Chuck Trail was so extensive that it most likely will need to be relocated. Current damage on this portion of the Darrington Ranger District Trail system is estimated at $650,000. The Kennedy Hot Springs area and cabin were destroyed or buried by the October 2003 flood event.

The watershed contains 62.5 miles of trail. Of the three difficulty levels, over seventy five percent are more difficult, twenty three percent are easiest and less than three percent are difficult. Over eighty percent of the trails are designated stock trails and seventy percent are within the Glacier Peak Wilderness Area. Some of the heaviest use of the trail system within the Glacier Peak Wilderness and on the Darrington Ranger District is along the White Chuck Trail, Pacific Crest National Scenic Trail (PCT) and the Boulder Basin Trail, which accesses one of the main Glacier Peak climbing routes. Use patterns may change due to extensive flood damage to the trails and roads in the White Chuck drainage.

This portion of the trail system receives annual to bi-annual maintenance with larger reconstruction projects completed as funding is found. Funds for both maintenance and reconstruction come from a variety of sources including Federal and State Grants, the Forest Service Trails Capital Investment Program, Northwest Forest Pass Program, and private donations. Work is completed by contracts, youth work programs, Forest Service crews, and various volunteers groups.

Meadow Mountain Trail was under analysis for reconstruction in 2004. Circle to Crystal Lake Trail was funded for reconstruction in 2003. Due to October 2003 flooding, the projects will be deferred for several years. A review of the current trailhead location of Crystal Lake and Meadow Mountain is currently under analysis. The PCT and other damaged trails are scheduled for repair in 2004- 2007. Past reconstruction includes:

- The upper White Chuck Trail was relocated in 2002 – 2003,
- The Kennedy Creek foot log at Kennedy Hot springs was replaced in 2002,

- Decking and handrails on Fire Creek Bridge on the White Chuck Trail were also replaced in 2002,
- The PCT between Red Pass and the upper White Chuck River crossing was reconstructed in 1990 – 1991,
- The upper White Chuck Bridge on the PCT and the lower White Chuck Bridge at Kennedy Hot springs were replaced in the mid 1990s,
- An analysis of the Kennedy Creek Crossing on the PCT was also completed during the mid 1990s and concluded the site to be too volatile and cost prohibitive to warrant installation of a stock or hiker bridge,
- The Everett Mountaineers reconstructed the White Chuck Bench Trail during the mid 1990s, and
- Contractors replaced the bridges at Crystal Creek and Black Oak on the White Chuck Bench Trail in 2000 –2002.

Table 37 Trail Designations

Trail Number	Trail Name	Primary Objective	Difficulty Level	Use Level	Area	Mileage
638	Crystal Lake Trail	Hiker	More Difficult	Low	Non wilderness	2
638.01	Crystal Lake Trail	Hiker	More Difficult	Low	Wilderness	.5
639	Kennedy Ridge Trail	Stock	More Difficult	Medium	Wilderness	2
643	White Chuck Trail	Stock	Easiest	Extra Heavy	Non Wilderness	.4
643.01	White Chuck Trail	Stock	Easiest	Extra Heavy	Wilderness	6.5
643.1	Kennedy Hot springs Camp	Stock	Easiest	Extra Heavy	Wilderness	.5
643.02	Upper White Chuck Trail	Stock	More Difficult	Heavy	Wilderness	2
646.01	Lost Creek Ridge / Lake Byrne	Hiker	More Difficult	Medium	Wilderness	6.5
646.1	Round Lake	Hiker	More Difficult	Medium	Wilderness	.7
657	Meadow Mountain	Stock	More Difficult	Medium	Non Wilderness	7
657.01	Meadow Mountain	Stock	More Difficult	Medium	Wilderness	10.6
663	Boulder Basin	Hiker	Difficult	Medium	Wilderness	1.8
731	White Chuck Bench	Stock	Easiest	Low	Non Wilderness	6.6
2000.06	Pacific Crest National Scenic Trail (Fire Creek Pass to Trail 639)	Stock	More Difficult	Heavy	Wilderness	5.9
2000.07	Pacific Crest National Scenic Trail (639 to GP LO)	Stock	More Difficult	Heavy	Wilderness	7.0
2000.08 (Portion of)	Pacific Crest National Scenic Trail (GP LO to Red Pass)	Stock	More Difficult	Heavy	Wilderness	2.5

Use levels are defined in the Forest Plan Appendix E, Page E-12.
Table E-1 Trail Inventory, p. E-17 – E-20.
Extra Heavy Use = 5000 plus users per year.
Heavy Use = 2501 – 5000 users per year.
Medium Use = 501 – 2500 users per year.
Low Use = 0 – 500 users per year

Future Trends

Prior to the flood event of October 2003, approximately 14.5 miles (23 percent) of the trail miles were in need of reconstruction. These trails include Kennedy Ridge, Lost Creek Ridge, Lake Byrne, Boulder Basin, and portions of the Pacific Crest Trail. Approximately 30 miles of the 62.5 miles of trail within the watershed have been reconstructed since 1990. This includes six major bridge replacements and numerous smaller puncheon bridges and walkways. This translates to 50% of the trail system being reconstructed over a 13-year period. Given these numbers it was reasonable to expect that the 14.5 miles in need of repair would be repaired within a 10-15 year timeframe. Much of the scheduled reconstruction will be deferred until the damage from the October 2003 flood is repaired. The repairs known so far include:

- Relocation of five miles of the White Chuck Trail;
- Reconstruction of the Kennedy Hot Springs Bridge across the White Chuck River and the Kennedy Creek footlog;
- Replacement of the Upper White Chuck Bridge, Switchback Creek Bridge, and Sitkum Bridge on the Pacific Crest Trail; and
- Reconstruction of several sections of the Pacific Crest Trail.

Due to the extensive nature of the flood damage within the White Chuck and adjacent watersheds, repairs may take up to ten years to complete. The expected timeframe for the previously scheduled reconstruction would therefore be extended by ten years.

Steep, unstable slopes, numerous stream and river crossings and high annual precipitation make the White Chuck a particularly dynamic watershed within which to maintain a trail system. The 1990s were also rough on the trail system with flood events causing extensive tread washouts, windfalls and bridge damage in 1990 and in 1995. The 1990s also saw a dip in trail maintenance and reconstruction budgets. In spite of budget shortfalls, most of the trail system received annual to bi-annual maintenance. While FS budgets appear to be declining other revenues sources such as NW Forest Pass and state, federal and private grant sources seem to be increasing. Given these funding sources it is reasonable to expect the current system will continue to receive the existing level of trail maintenance with possible increases as budgets allow.

There are several proposed trail construction projects within the watershed. These include White Chuck Mountain (1.0 Mile), Thorton Lake Trail (1.5 Mile) and the White Chuck Trail extension, (6.0 Miles). Proposed trails are as shown in *MBS National Forest Land and Resource Management Plan,* Appendix E, Table E-1 Trail Inventory, Pages E-17 – E-20.

Dispersed Recreation

There are three to four dispersed camping areas along Road 23 and the White Chuck River including one near Crystal Creek, which has three campsites. These sites may have been damaged in the October 2003 flood. Most of the White Chuck area is currently inaccessible due to the October 2003 road washout near the beginning of Road 23 The White Chuck Trailhead (Owl Creek) has three campsites near the trailhead plus people camp next to their cars since the parking area is large and grassy. There are some campsites on Road 27 near Rat Trap Pass and before the Meadow Mountain Trailhead. Most of the White Chuck developed campground was washed away in the 1990s, with six campsites remaining between the campground and the White Chuck Launch. The White Chuck Overlook has three accessible picnic sites and one toilet. Other dispersed activities include scenic driving, fishing, hunting, berry picking, mushroom collecting, and cross country skiing.

Visual Resources

Road 23 is within Management Area 2A - Scenic Viewshed Foreground. The goal of Scenic Viewshed is to provide a visually appealing landscape as viewed from major travel corridors and use areas. In this area, Road 23 is the major travel corridor. The visual quality objective along Road 23 is retention. Roads within the seen area should blend with natural form, line, color, and textures and cut and fill slopes should be revegetated within one year of construction. The middle ground views outside of wilderness have accommodated a variety of activities that are visually subordinate to the natural landscape.

Recommended Recreation River

Much of the White Chuck River is also within a Recommended Recreation River (5A) Management Area. The goal is to protect from degradation the outstanding remarkable values and wild, scenic, and recreation characteristics, pending a decision on inclusion into the National Wild and Scenic River System. The desired future condition within 5A is that evidence of a full range of management activities may exist. The river is currently inaccessible by road and bridge crossings. Streamside bank is generally in a natural condition.

Outfitter and Guides

There are five land based outfitters and guides who operate in the White Chuck drainage within the Glacier Peak Wilderness. The outfitters and guides along with their historical amount of user days in the analysis area are listed below.

Table 38 Outfitter Guide Use Days

Company Name	Use Days	Activity
American Alpine Institute	141	Climbing Glacier Peak
Alpine Ascents International	200	Climbing Glacier Peak
Base Camp	24	Climbing Glacier Peak
Reach Out Expeditions	132	Climbing Glacier Peak
Wilderness Ventures	240	Backpacking PCT

Since 1999, the Mt. Baker-Snoqualmie National Forest has implemented a moratorium on permitting further commercial use until an outfitter guide and resource needs analysis is conducted. That is not to say that this moratorium has prevented other non-permitted companies and individuals from guiding. Decreased wilderness patrols have made it difficult to monitor illegal guiding activity.

Mining and Minerals

There was an active pumice mine before 1960 near the beginning of Road 23 and below the present day White Chuck Overlook. There are no known mining claims within the watershed.

Heritage

Very little archaeological research regarding prehistoric use of the upriver and mountain regions of western Washington has been conducted. The first surveys of the Sauk River Valley and its tributaries were conducted for the Northern Pacific Railroad in 1870. Although the valley did not become a major railroad route, the Sauk-Monte Cristo Wagon Road (1889-1891) provided access to various homesteads along the Sauk River and encouraged mining exploration in the Monte Cristo area.

Prior to the 1920s, relatively little timber harvest occurred in the Sauk River valley and its tributaries. In the 1930s, railroad logging proceeded in earnest and continued into the 1940s, when cable logging and truck hauling became the principle method of harvest. The Sauk River Logging Company had established numerous camps along the Sauk River and it's tributaries including one near the mouth of the White Chuck River. These sites and grades are now recognized as a historic district.

The Kennedy Hot Spring area was used by early trappers and prospectors. Camp Creek Shelter was along the old trail to Kennedy Hot Spring Camp. In 1924, the Forest Service built the Kennedy Guard Station. The guard station provided a headquarters and place to store equipment and supplies. The first fireguard was stationed at Kennedy in 1926. In 1964, the area became part of the Glacier Peak Wilderness and the occupant of Kennedy Guard Station was now known as a wilderness ranger. Recreation use began as early as 1927 when a Seattle Mountaineers group climbed Glacier Peak.

Tribal Use and Treaty Reserved Rights

The White Chuck River was the ancestral territory of the present day Sauk-Suiattle tribe. Salmon fishing may have occurred at the mouth of the White Chuck. Parts of the White Chuck Watershed were used for plant gathering and hunting.

Traditional American Indian uses include fishing, hunting, and gathering. As rivers swelled with the return of anadromous fish, camps were temporarily set up. Steelhead was the most important fish resource because of its availability throughout the year (Lane and Lane 1977). A number of travel routes were accessed by trail and canoe. The stream banks were preferred for lowland foot travel because they were easier to negotiate than the forest. Canoe was used in the navigable rivers (Majors and McCollum 1981). Plants gathered in season included: blackberries, elderberry, cedar bark, and several of the other forest and river valley species used for food, material and medicines (Hollenbeck 1995). In the early 1900s, Mt Pugh was known as a favorite site to collect huckleberries. Hunting was an important substance for the tribe, which included a variety of animal species such as the mountain goats inhabiting White Chuck Mountain.

Current uses of the watershed by Indian tribal members include the exercise of treaty rights and practices of ceremonial and religious significant. The privacy and purity issues surrounding these practices are of concern to the Indian community. Treaty reserved rights include the rights to hunt and gather on open and unclaimed lands, and to fish at usual and accustomed grounds and stations. Data on the extent to which hunting and gathering rights are exercised are not available.